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ABSTRACT

This final report discusses the outcomes of a federally funded project that studied visual, auditory, and tactual methods designed to give youth with visual impairments access to microcomputers for curricular, prevocational, and avocational purposes. The objectives of the project were: (1) to research microcomputer systems that could be made accessible to youth with blindness through print, voice, and touch; (2) to develop and evaluate instructional programs for teaching youth with visual impairments to use microcomputer systems through multimedia access; (3) to develop and evaluate instructional packages for these multimedia microcomputer systems for the inservice and preservice training of special education and other personnel who work with youth with visual impairments; (4) to evaluate selected, adapted, or specially development computer-assisted instructional programs for curricula, prevocational, and avocational purposes; and (5) to disseminate the results and products of the research project through usual dissemination channels. The report identifies the advantages and limitations of cassette Braille devices, OPTACON (Optical-to-Tactile Converter), speech synthesis, digitized speech, and large print. Appendices include procedures for interfacing the IBM PC with the VersaBraille instructional modules for beginning microcomputer and access technology skills for students with visual impairments, and a Braille-edit student instructional module. (Contains 55 references.) (CR)

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ED 408 812

RESEARCH ON MULTIMEDIA ACCESS TO MICROCOMPUTERS FOR VISUALLY IMPAIRED YOUTH

FINAL REPORT

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Research on Multimedia Access to Microcomputers for Visually Impaired Youth

Many people have helped us with this project. A number of teachers and administrators and the visually impaired students they serve, both on and off campus, contributed substantially to the project through field trials and expert review of products of the project.

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dissertation focused on an important aspect of the project, was extremely helpful in many ways. We congratulate her on the attainment of her doctorate. LaRhea Sanford, whose dissertation is also focused on an aspect of the project, has been of help in many ways and we have benefited from her previous experience in such work with the American Printing House for the Blind. Anna Bradfield, Cathy Mack, Alan Koenig, Nassir Mosa, Mark Demuth, and other graduate students too numerous to name but whose help we gratefully acknowledge, were important to the project.

Finally, we are grateful to the Office of Special Education Programs of the U. S. Department of Education for the funding and facilitation that enabled us to complete this project. We believe it will be of significant benefit to large numbers of visually impaired persons as they learn to use these very powerful tools to enhance their education and their work.

S. C. Ashcroft

Principal Investigator

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INTRODUCTION

INTRODUCTION

Computers are an extension of human intelligence (Lipson, 1980). Today they pervade almost every aspect of life. They are everywhere--in kitchens, offices, cars, trucks, grocery stores, game arcades, garages, everywhere--but perhaps least of all, in schools and classrooms where human intelligence and cognitive development are nurtured. In "Microcomputes Applied to Education," Joseph Lipson (1980) of the National Science Foundation said, "We need to more fully grasp the nature and power of the computer as an extension of human intelligence. Only then will we be able to design learning environments that orchestrate the fantastic range of possibilities that the new technologies have opened for us."

A visit to a classroom makes it strikingly evident that computers have as yet had relatively little impact in school classrooms as compared to their impact elsewhere. The early promise of computer-assisted instruction (CAI) has not been realized (Kearsley, Hunter, and Seidel, 1983). Many persons would attribute this disappointing situation to a lack of funds and to a lack of understanding of how to use this powerful technology. Presently, the power of computers is said to be doubling every two years. Today's inexpensive microcomputers are more powerful than the room-sized computers of a few years ago. Today's inexpensive but increasingly powerful microcomputers are making their appearance in regular classrooms and will have a significant impact on the curriculums in regular education programs.

School personnel must learn to understand and use these powerful tools. It is imperative that special education classrooms keep pace with the rapid infusion of technology into regular education. If special education students can be given approximately equivalent access to microcomputers, they can participate more fully in classroom activities with their peers in regular education. Equally important, special students will be prepared to compete more equitably for computer-related jobs, significantly increasing their employability and employment. Without roughly equivalent access, special education students will be doubly handicapped.

The special education of visually impaired students is unique and urgently in need of action to enable visually impaired students and those who work with them to enter the information and technology era and to become contributing citizens in the information society. Practice must be brought into accord with "state of the art."

We know far better how to educate blind children than we do in fact educate them. The state of the art is much better than the state of our practice. This situation is especially true in applications of technology to our practice. Thomas Gilhool (1982) has called attention to what he labeled the "technology-forcing role of the law." He indicated that when Congress enacted P.L. 94-142, it "was deeply aware . . . that we know how to educate disabled children effectively . . . but that knowledge has not been widely distributed. "Thus," he says "the

Congress included phases and provisions that were designed to evoke . . . to force, if you will--that technology . . . it is of course forcing distribution of technology." Gilhool continues by calling attention to ". . . the requirement for the use of the °state of the art' as distinguished from the °state of the practice'."

According to John Naisbitt (1982), "we are living in the time of the parentheses, the time between eras. As we move from an industrial to an informational society, we will use our brain power to create, instead of our physical power, and the technology of the day will extend and enhance our mental ability . . . yet the most formidable challenge will be to train people to work in the information society." What the opportunities for visually impaired people will be in the information society is only now dimly glimpsed. What is known, however, is that too little is being done to enable visually impaired persons to function effectively in this era of technology, and to participate comfortably in the information society.

Naisbitt (1982) also indicated, "by one estimate, 74% of all jobs by 1985 will involve computers in some way--and people who don't know how to use them will be at a disadvantage . . . Although computer use in public education is still in its infancy, schools around the nation are beginning to realize that in the information society, the two required languages will be English and computer." Molnar (1980) pointed to the next great crises in American education and concluded that, "there is a national need to foster computer literacy . . . in spite of the fact that results of research are published in journals which are widely available, scientific knowledge does not become a relatively freely available good until it becomes part of the educational curriculum. How do we introduce new innovations into education? . . . Education is textbook-bound and today's books make little or no reference to computer-based advances. A national effort is needed to introduce computing into our nation's textbooks."

The report of the Office of Technology Assessment (1982) indicated that, "modern society is undergoing profound technological and social changes brought about by what has been called the information revolution." Their report continues, "a key element of all of these educational needs is that they will constantly change. In a rapidly advancing technological society, it is unlikely that the skills and information-base needed for initial employment will be those needed for the same job a few years later. Life-long retraining is expected to become the norm for many people." The same report indicates that, "the Office of Technological Assessment found little evidence of current hardware limitations that would limit the applicability of technology to education and, hence, call for major research efforts. Continuing research in the general fields of computer science and engineering, coupled with innovative private sector development, will provide the necessary hardware base. The only exception is the area of technology for the handicapped where it is not clear that the opportunities for developing specialized technology could be met without some federal support for R & D" (emphasis added).

The report also focused on teacher training. Widespread use of technology in the classroom will require that teachers be trained both in its use and in the production of good curriculum materials. Too few teachers are so qualified today. Schools maintain that they are already faced with a shortage of qualified science and mathematics teachers (those most likely to lead the way in computer-based education). Furthermore, there is little evidence that most of the teacher training colleges in the United States are providing adequate instruction to new teachers in the use of information technology."

Fortunately, educators in the United States are beginning to respond to the revolution. Papert (1980), in the "Computer in the School," writes about teaching children thinking. He cautions, "the phrase technology in education' usually means inventing new gadgets to teach the same old stuff in a thinly disguised version of the same old way. Moreover, if the gadgets are computers, the same old teaching becomes incredibly more expensive and biased toward its dullest parts, namely the kind of rote learning in which measurable results can be obtained by treating the children like pigeons in a Skinner box." Papert (1980) presents, ". . . a grander vision of an educational system in which technology is used not in the form of machines for processing children, but as something the child himself will learn to manipulate, to expand, to apply to projects, thereby gaining a greater and more articulate mastery of the world, a sense of the power of applied knowledge, and a self-confidently realistic image of himself as an intellectual agent. Stated more simply, I believe with Dewey, Montessori, and Piaget that children learn by doing and by thinking about what they do. And so, the fundamental ingredients of education innovation must be better things to do and better ways to think about oneself doing these things."

Many colleges and universities are now requiring their graduates, including their teacher education graduates, to be computer literate. In addition, there are national support systems developing that are critical to intelligent use of computer science and technology in education. An example is the Micro-SIFT Project of the Northwest Regional Laboratory. It is a source of excellent information both on software and hardware. It has provided through the Educational Resources Information Centers (ERIC) one of the better evaluator's guides and the project continuously reviews critically needed software and courseware. This information is subsequently made available through an electronic data base, RICE (Resources in Computer Education).

Fortunately, attention in special education is being turned to the technology, information revolution, computers, and computer science. Taber (1981) provides an excellent review of microcomputer capabilities and applications. She says, "using the microcomputer to benefit the handicapped is probably the most exciting development for this medium (page 5)." Taber concluded, "educators had better get ready for a new wave in education, because education as we know it today will soon be antiquated for communication as the quarter picture show or the Pony Express ... the sky is the limit when creative educators team up with creative computer technologists. In special education, our job must involve the fast-developing uses of technology to assist the handicapped: in their quest for normalization (page 14)."

Much can be said and written about the needs of visually impaired persons, but without implementation there is no effect. Microcomputers offer a medium for enhancing and improving special education services. Microcomputers and other technological developments must be made increasingly accessible where human intelligence and cognitive development are nurtured and where the extension of human intelligence is of critical importance.

Since the computer is an extension of human intelligence, blind individuals must not be additionally handicapped or multiply handicapped by lack of full access to such an important resource. Technology can make life much easier for handicapped persons but it can also make it more difficult, especially to stay abreast of rapidly changing developments and to be eligible to compete for employment opportunities where elaborate technology is involved. However, recent developments in computer technology can be of immense value to visually impaired persons. Microcomputers can be made accessible through a wide array of options ranging from conventional video displays to talking terminals. Currently available technological developments enable relatively low-cost access through various formats. These formats include different type sizes on computer displays to accommodate different levels of visual acuity; various modes of tactual access such as through conventional paper braille or through cassette braille technology and through the OPTACON (OPtical-to-TActile-CONverter), which provides a tactual counterpart of a printed image. Alternatively, or as a supplement, reasonably priced voice synthesizers can also provide an easily learned means of accessing microcomputers.

In their book, "Training the Handicapped for Productive Employment," Weisgerber, Dahl, and Appleby (1981) suggested useful strategies for overcoming the mismatch between environmental demands and individual capabilities. These strategies are (a) to alter the capabilities of the person so that environmental demands can be satisifed,(b) to provide an environment that eliminates a mismatch,and (c) to provide a device to smooth the interface between the person and the environment at the point of interaction. This research project made use of all three of these strategies. The capabilities of visually impaired youth and their teachers were changed so that they could utilize cassette braille recorders, microcomputers, talking terminals, and other equipment used to make computers accessible. An environment that provided a talking terminal reduced a mismatch between visually impaired youth and a microcomputer. The equipment utilized in this project also smoothed the interface between the person and the technological environment at the point of interaction.

Special Education programs for visually impaired persons must be prepared to acquaint visually impaired persons with the recent technological developments represented by microcomputers if their students are to be competent and employable in today's rapidly developing technological world. To accomplish this purpose, equipment must be made accessible and those who work with visually impaired persons must be informed about the technology, be comfortable with its use, and recognize its value to their programs. The present research on multimedia access to microcomputers for visually impaired persons for curricular, prevocational, and avocational uses was designed to accomplish this purpose.

REVIEW OF LITERATURE

Research directly related to the proposed project is meager and few reports are found in the literature. Information about related developments comes largely from personal communications, word-of-mouth, newsletters, and an informal network of interested individuals. We are grateful to our Project Officer for current and recently completed work, for frequent leads to related developments and for information regarding other interested individuals.

The following briefly covers directly related studies.

Microcomputers

Microcomputers have become increasingly common due to their ability to perform the same functions as ordinary computers although they perform at a somewhat slower rate (Turnblade, 1970). The market for home and hobby computers is growing at an astounding rate, not only because the cost of a microcomputer is now more nearly within the means of the average family, but also because the mystery surrounding computers is diminishing as computers become more a part of our daily lives.

The development of versatile software offers the microcomputer owner limitless possibilities for computer use. Most computer manufacturers, such as IBM, Hewlett-Packard, Radio Shack (Tandy Corp.), and Apple, market business, educational and/or hobby programs, and other software features such as video, print, and vocal outputs, additional memory storage capacity, telephone couplers, and a variety of terminals. The many potential benefits of microcomputers have been summarized by a number of authors. Taber (1981) lists 14 different ways in which microcomputers have proved beneficial to special educators, and quickly adds, "With imagination, this list can become endless!". Their aid for physically handicapped individuals has been documented by Morgan (1983) and by Tracy (1983). Sloan & Hannaford (1981) list 24 potential benefits of the use of microcomputers by special education. The literature on applications of computers to special education is growing rapidly.

Programs Available for Instructing Blind Youth in the Operations of Computers

Computer assisted instruction (CAI) has been in existence for more than twenty years. Advocates of CAI contend that compensatory education has largely failed due to many factors including the lack of individualization (Jameson, Suppes, & Butler, 1970), and that CAI could be used to overcome some of the deficits in compensatory education. By providing individual attention, copious rote practice, and the particular rate of instruction needed by an individual student, CAI has been used to supplement instructional programs in most academic areas for all ages of students.

The literature on CAI with visually impaired children is sparse. The Cincinnati Public Schools (Morgan, 1975) developed CAI in mathematics and reading for 350 hearing impaired and 30 visually impaired elementary school aged children. Access and participation by the visually impaired students was largely impossible, however, due to the lack of hardware and software necessary to produce braille media, and due to an inability to find an optical system appropriate for the majority of partially sighted students.

The Overbrook School for the Blind (Evans & Simpkins, 1975) developed a computer instructed mathematics program for their fourth, fifth, and sixth grade students. Students used a typewriter terminal interfaced with a braille adaptor developed by Triformation, Inc., to interact with the program. Although 43 subjects used the program for 20 minutes per day, no formal evaluation results were reported. Many packaged instructional programs, such as Program Logic for Automatic Teaching Operation (PLATO) (Lyman, 1970), Lincoln Training System (LTS) (Butman, 1973), Total Information Educational System (TIES) (State of Minnesota), and Time-Shared Interactive Computer-Controlled Information (TICCIT) (Rappaport, 1974) have not been easily accessible to the visually impaired student. However, the feasibility of accessing these programs through multimedia approaches needs to be explored.

The possibilities for learning about and for using computers are increased when children are taught programming skills, considered by some the most important form of computer literacy. Most urban high schools now offer courses in computer programming as electives, or as a component of the math program. Computer programming, as a career, has become appealing to blind individuals who meet the criteria for entry into the field

(Charleston, Sheffield, Segel, & Miller, 1976; Geldea, 1970; Halenbeck, 1971). Students with prior experience in programming microcomputers have an advantage in learning to become professional computer programmers over those without such experience. In fact, when a mini-computer was added to the learning resources available for students of computer programming at the University of California at Santa Barbara, it was found that these students performed better on the course examinations than did students using the traditionally-aided instruction (Attala & Howard, 1974). Thus, there is a need for an investigation into the possibilities of teaching visually impaired children to use computers with instructional programs and to program computers for educational and future career purposes. Multimedia interfacing with microcomputers enabled the visually impaired students to interact with computers and specific programs through media with which they were familiar.

Since many school systems are rapidly taking advantage of microcomputer technology to provide remedial and supplementary instruction, to introduce computer programming, and to enhance their regular curricula, and since the technology is available to mediate these experiences for visually impaired students, research into the nature of the modifications and supplementary instruction for the visually impaired students was conducted.

Braille Output

Instruments to convert computer output to braille have been available for some time. As early as 1967 (Ward) Michigan State

University developed a system that used a computer to convert alpha-numeric text to braille and then to audio for recording on tape. The tape was played on a display unit containing 30 braille cells which was similar to a portable tape recorder in size.

The University of Dayton (1970) developed the Model 33 Teletype which printed computer code in braille. It is interesting to note that an extra dot was added to the ordinary six-dot braille cell in this project. According to their report, the braille teletype enabled a blind computer programmer to be totally independent.

The Braillemboss, a product of the Massachusetts Institute of Technology (Dalrymple, 1975), was a braille-writing teletype which could be added to the usual hardware of a computer. The instrument could produce Grade II braille. It was used successfully by blind computer programmers, newscasters, and tax representatives to perform their work independent of a sighted interpreted.

A braille translator specifically designed for use with the mini-computer is the Duxbury Braille Translator produced by Duxbury Systems, Inc. (1976). This translator produces "standard English braille (Grade II) at speeds in excess of 1,000 words per minute when installed in a typical mini-computer, and at proportionately faster rates when installed in larger computers" (page 35, 1976). Thus, with this device came the wedding of the braille translator and the mini-computer. Today the Duxbury Braille Translator can also be used with a microcomputer for almost $1,000 less than with a mini-computer (Sullivan, 1977) and has recently become available for the Apple II microcomputer.

Although there are several different print-to-braille translation schemes available, they typically produce less than perfect Grade II braille. However, the recently available Braille-Edit program, produced by David Holladay, provides not only high quality Grade II translations, but also provides many of the features of word processing software. Because many computer characters do not have corresponding braille symbols, new systems have had to be invented. This could result in reading confusions unless students are sufficiently trained to recognize these new characters.

Instructional Materials

A review of the literature concerning available computer textbooks for elementary and secondary school aged children was carried out. Bibliographies of various computer programming, history, and literacy texts were compiled. A cursory review of available computer texts in braille was undertaken. Many of these texts are outdated; the general focus of these texts is not on teaching computer skills to youth. It is apparent that much work is needed in the area of computer curriculum development for braille readers.

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PRIOR PROJECTS

The research carried on in this project complemented a number of then current developments in the field. Among these were: the Cassette-Braille Technology Study that was conducted by the Library of Congress, National Library Service for the Blind and Physically Handicapped. This cassette-braille evaluation was designed to evaluate VersaBraille machines in Los Angeles and Digicassette machines in Baltimore and Oklahoma City. Braillocord research was carried on at Clovernook Printing House for the Blind in Cincinnati, Ohio.

The November 1980 FACTS, Newsletter from the National Library Service, included reports on these developments as well as indicating that the NLS had reviewed a study by the present investigators on cassette-braille in educational settings.

During the project, we kept in current contact with Telesensory Systems Incorporated on developments with respect to VersaBraille, Optacon, Talking Optacon, and other developments. Sandy Ruconich, graduate assistannt in the project, served as a consultant to Telesensory Systems and assisted with the development of instructions for operation of VersaBraille. She recently participated in a European Seminar in Genoa, Italy with Optacon users, teachers, and other professionals in the international arena of services to the blind.

The Evaluation and Research Program for the Portable Braille Recorder enabled us to maintain regular communication with ELINFA and later with Triformations Systems to keep up with developments on the Digicassette and new equipment as is became available for hard copy braille, for the newer model Digicassette with a built-in micro processor, the Free Scan Speech Terminal, and the Braille Translation System.

Maryland Computer Services specializes in development of voice synthesizer systems for use by blind persons. They have developed the Talking Telephone Directory, Talking Information Management System, Full Speech Terminals and other devices that are widely used by such agencies as the Sensory Aids Foundation, Baruch College, Arkansas Enterprises for the Blind, the University of Kentucky, Office for the Blind of the Department of Education, etc.

Kurzweil Computer Products has developed the widely known Kurzweil Reading Machine for the Blind. The Kurzweil company is currently developing a Talking Computer Terminal that holds much potential for visually impaired youth.

The American Printing House for the Blind plans to make available paperless braille recorder tapes for braille books produced by computer tape in their Books for the Blind and Act to Promote the Education of the Blind programs.

Baruch College, New York has a computer center for the visually impaired. It has an extensive computer complex including talking terminals, a braille telephone directory, and other devices. We have benefited from communications in selecting the equipment we proposed to purchase.

ARTS Computer Products, Inc., of Boston are also developing a Talking Terminal. They are experienced with braille translation equipment and other programs for blind persons.

A number of individuals, talented persons who are themselves blind, have worked on configurations of computers, paperless braille recorders, and related devices. Among these individuals are Peter Maggs of Champaign, IL; Timothy Cranmer of Services for the Blind in Frankfort, KY; Fred Sinclair, Specialist on the Visually Handicapped, California State Department of Education, Sacramento, CA; Emerson Foulke, Director, Perceptual Alternative Laboratory, University of Louisville, KY.

The foregoing represent major developments in the area of technology for blind persons with special emphasis on computers, microcomputers, and multimedia modes of access for visually impaired persons. It is interesting to note that all of these agencies and individuals seem to agree on future directions of multimedia access to computers for visually impaired persons, the focus of the present grant application.

MICROCOMPUTING (December 1980), formerly KILOBAUD included an article entitled, Speech Synthesis for the 6800 by Mayhugh who said,

> A Speech Synthesizer is one of the most exciting peripherals that a hobbyist can add to a home computer system. Computerized speech synthesizers open the door to almost unlimited new uses for a micro, ranging from pre-school computer aided instruction to I/O for blind users.

In the December 1980 issue of CREATIVE COMPUTING, Vol. 6, No. 12, p. 26-27, a Christmas buyer's guide of ten computers was provided. The computers included in this guide were selected with the aim of giving a wide representation to as many different types of computers as possible. They included TRS-80 Model II and the Apple II Plus.

BYTE magazine, November 1980, indicates that the Tandy Corporation Radio Shack Computer and the Apple Computer joined the Commodore Computer among the top performers as personal computers. As indicated there, "Each year DATAMATION analyzes and rates the top 100 computer companies. For the second year in a row, Tandy Corporation (parent company of Radio Shack), Apple Computer, and Commodore have made that list. In fact, for this past year, Tandy ranked 39th (last year, 58th), Apple ranked 61st (last year, 100th), and Commodore ranked 75th (last year, 94th); these three personal computer makers had the highest growth rates of the top 100 computer product vendors in the U. S."

A Peabody-Vanderbilt study (Gray, 1980) Master of Science thesis entitled "A Pilot Study of an Introductory Course on the TRS-80 Microcomputer for Visually Impaired Students," encourages further research in the directions delineated in the present proposal since it concluded, ". . . that an introductory course on the TRS-80 microcomputer designed for use by visually impaired secondary students was successfully completed by this particular group of students from a residential school (Tennessee School for the Blind) for the blind. Having taken the course, the students evidenced a level of interest sufficient to desire further exposure."

Summary

Interest in computers is expanding rapidly. Inexpensive microcomputers with increased sophistication have become widely available. There is a resurgence of interest in computer assisted instruction and many CAI materials of good to doubtful quality are being marketed.

Visually impaired youth will be multiply handicapped if they are denied access to computer technology while their seeing counterparts are benefitting from these new and rapidly expanding developments. Fortunately, there is a confluence of many new developments in technology for the visually impaired with the new developments in computer technology that can give visually impaired persons parity in access. Research, developments, and evaluation of the promising possibilities is urgently needed. The proposed research is responsive to the needs.

DEFINITION OF TERMS

For purposes of this research certain terms are defined as follows:

COMPUTER-ASSISTED INSTRUCTION. Computer-assisted instruction (CAI) means educational material presented by means of digital electronic equipment designed for interactive learning.

CURRICULAR. Curricular means school subject matter and academic course offerings of special education programs for visually impaired youth.

PREVOCATIONAL. Prevocational means school activities specifically designed to prepare visually impaired students for entry into vocations, occupations, and employment or further vocational training.

AVOCATIONAL. Avocational means pursuits or hobbies which are followed for recreational purposes by visually impaired youth.

MICROCOMPUTER. Microcomputers are defined as the Tandy Radio Shack TRS-80 Microcomputer (Models I and III), the Apple II Plus and Apple IIe Microcomputers, and IBM-PC Microcomputer.

CASSETTE BRAILLE RECORDERS. Cassette braille recorders are defined as the VersaBraille, P-2 (A, B, and C) of Telesensory Systems, Inc.,; Microbrailler by Triformations, Inc.; and other cassettee braille recorders.

MULTIMEDIA. Multimedia means visual (print and large type), auditory (voice synthesis), and tactile (braille in paper and paperless forms and tactile print-Optacon).

INSTRUCTIONAL PACKAGES. Instructional packages are teaching materials and media to instruct teachers in the use of the equipment and to allay their fears about such technology.

ACCESS TECHNOLOGY. The equipment or devices, equipment interfacing strategies, software, firmware, instructions and materials enabling independent use of microcomputers by visually impaired persons.

INSTRUCTIONAL PROGRAMS. Valid, systematic instructional materials designed to aid teachers in training visually impaired students to use microcomputers and associated special access equipment.

PROJECT DESCRIPTION

STATEMENT OF OBJECTIVES

This project was designed to study visual, auditory, and tactual methods to give visually impaired youth access to microcomputers for curricular, prevocational, and avocational purposes.

The five objectives pursued by this project were:

1. To research microcomputer systems to be made accessible to blind youth through print, voice, and touch (new versions of cassette braille recorders and Optacon-tactile print).

2. To develop and evaluate instructional programs for teaching visually impaired youth to use microcomputer systems through multimedia access.

3. To develop and evaluate instructional packages for these multimedia microcomputer systems for the inservice and preservice training of special education and other personnel who work with visually impaired youth.

4. To evaluate selected, adapted, or specially developed computer-assisted instructional (CAI) programs for curricular, prevocational, and avocational purposes.

5. To disseminate the results and products of the research project through usual dissemination channels.

EQUIPMENT DESCRIPTION

It was essential that the systems studied by this project be easily available, appropriate for widespread use and readily acceptable by visually impaired students and programs serving visually impaired students throughout the nation. Therefore, our program was limited to the review of commercially available peripheral equipment and software for use as access technology. No special equipment was developed nor was existing hardware substantially altered in this project. The use of unaltered "shelf-stock" equipment gives the findings of this project the necessary external validity and generalizability. Figure 1 titled, "Access Technology for Microcomputers for Visually Impaired Students," developed as a product of the project, indicates the range, variety, and some of the features of peripheral equipment and access software included for study. As also indicated in Figure 1, the students we work with have vision ranging from near normal tp none.

INSERT FIGURE 1 ABOUT HERE

The access technology ranges at one extreme from standard, nonspecialized, unadapted equipment requiring little learner adaptation to the nonstandard and highly specialized equipment required by learners needing very substantial adaptation at the other extreme. As Figure 1 indicates, the access technology may include devices ranging from regular computer displays on

Figure 1

Access Technology for Microcomputers for Visually Impaired Students

ACCESS TECHNOLOGY: THE EQUIPMENT, EQUIPMENT INTERFACING, SOFTWARE, INSTRUCTION AND MATERIALS ENABLING INDEPENDENT USE OF MICROCOMPUTERS BY VISUALLY IMPAIRED PERSONS.

Numbers of Persons Served	Visual Acuity Continuum	Microcomputer Access Devices and Arrangements	Degree of Specialization Continuum	Primary Modality Utilized-Vision Audition or Toucn			Input/Output Capability of Device	Graphics Capability/Accessibility
				V	A	T		
Potential to Serve Most Users	Normal Vision	Regular computer display (CRT) or hard copy (paper) print-out, normal print size	Least Nonstandard and Specialized Equipment Required	X			I/O	visual graphics only
		External adjustable or adaptive devices to put CRT display in vision range		X			0	could provide enlarged visual graphics
		Voice synthesis as supplemental mode of access		X			0	requires specialized software to be developed
Least Learner Adaptation and Special Instruction Required		Clear, good contrast and/or enlarged print on CRT screen		X			0	could provide enhanced visual graphics
		Hardware or ROM-generated large type		X			0	may require graphics enlargement
	Partial Vision	Software-generated large type		X			0	may require graphics enlargement
		Externally-magnified large type - optically magnified by stand- or hand-held magnifiers		X			0	could enlarge parts of graphics
		Electronically-enlarged type - via closed circuit TV		X			0	could enlarge graphics
	Low Vision	Voice synthesis as sole mode of access; special terminal - e.g., Maryland Computer Services ITTS or Total Talk			X		0	requires supplemental specialized graphics
		Print character recognition with voice synthesis readout - e.g., Kurzweil Reading Machine			X		0	requires supplemental specialized graphics
		Cassette braille machine - paper readout - Perkins terminal - braille keyboard				X	I/O	can reproduce tactile graphics from CRT visual graphics
		LED-120 - braille print machine and terminal - paper readout - regular keyboard				X	0	has potential (needs software to be developed) to fully reproduce graphics
		Cassette braille machines - movable pin displays - VersaBraille, Microbrailler, and others				X	I/O	cannot facilitate graphic use
Most Learner Adaptation and Special Instruction Required	No Vision	Proposed tactile graphics display - as stand-alone device or as dumb terminal - no keyboard or possible braille keyboard	Most Nonstandard and Specialized Equipment Required			X	I/O	could reproduce graphics from the screen in tactile form
Potential to Serve Fewest Users		Optical-to-tactile converter - Optacon - with CRT lens - no computer input capability				X	0	can display small segments of graphics

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ordinary monitors and cathode ray tube screens or hard-copy printout in normal print size to complex cassette braille machines and devices using optical character recognition and voice synthesis. Ordinary computer displays can be used by some students such as those with good central vision but with restricted peripheral fields that qualify them as visually impaired for educational purposes. Large monitors such as those having 19-inch CRTs can meet the needs of some visually impaired students. Enlarged print on the CRT screen generated either through hardware or software is utilized by students with partial vision. Such students can also utilize regular displays enlarged externally by stand-mounted or hand-held magnifying devices. Other students with partial vision find it necessary to use the electronically enlarged type provided through closed-circuit television (CCTV). These CCTV devices have the flexibility of variable fields of view with peripheral distortion and powerful zoom lenses for extreme variation in print or graphic size. Voice synthesis can be used either as a supplemental, or as the sole, mode of access. The Echo II is an inexpensive voice synthesizer designed for the Apple computer. Voice synthesis is also available in special terminals such as the Total Talk Terminal distributed by Maryland Computer Services, which provides a great deal of flexibility since it is specially designed for the visually impaired user. Voice synthesis readouts are also available through a print character recognition device, the Kurzweil Reading Machine, the only such equipment as yet currently available.

Equipment for access through tactual means has become increasingly available during the past five years. The newest device in this category is the Perkins Terminal, a cassette braille machine with paper readout and utilizing a braille keyboard. This electronic braille reading and writing equipment is an adaptation of the familiar Perkins Braille Writer and is being marketed at $2,750.00 by Maryland Computer Services. Sandy Ruconich, a doctoral student who has been a research assistant in our project, is studying an audio-tutorial approach to providing a user and instructional manual for this new device. Preliminary data indicate that such an audio-tutorial approach using both audio-cassettes and braille materials designed with teacher and student users in mind will be significantly more effective than audio or traditional braille materials. We expect also that this dissertation will set a precedent for future user manual development.

Braille printing machines and terminals have been available for some time, but up to now have been extremely expensive and lacking in portability. They provide a paper readout and regular computer keyboard terminal input.

Cassette braille machines with movable pin readout, such as VersaBraille and Microbrailler, first became available in 1977 (Ashcroft, 1979). They have improved rapidly in sophistication and reliability but remain scarce and expensive. Update, the monthly newsletter of the Sensory Aids Foundation (February, 1984), provides a comparison of VersaBraille and Microbrailler 2400.

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A proposed full-page braille and tactile graphic display is being developed by the American Foundation for the Blind as a stand-alone device or to be used as a dumb terminal. This device will be an invaluable addition to access technology for microcomputers as well as having numerous other applications. Currently, microcomputer software programs including graphics are virtually inaccessible to visually impaired students without remaining vision. The refreshable tactile graphic display has the potential to make accessible much of the software employing graphics.

The last mode of access listed is the OPtical-to-TACtile CONverter (OPTACON). This device presents a tactile counterpart of visual symbols, one character at a time and when used with a CRT lens, can make the CRT display accessible in tactual characters to the visually impaired person.

At the current stage in the development of access technology, much remains to be learned about interfacing access equipment and microcomputer equipment. Distributors rarely provide adequate information in a form usable by naive persons to readily interface equipment for reliable operation. Personnel with computer programming expertise are essential and it is highly desirable also to have available expertise in communications and electronics. Personnel who have, or are willing to acquire, competence with braille can be of great assistance. There are frequent needs for "trouble shooting" technical assistance to avoid the frustrations of balky or malfunctioning equipment and the problems of interconnecting (interfacing) various equipment configurations to meet the individual needs of diverse visually impaired users.

In pursuing our fundamental objective to make microcomputer systems accessible, we have used the Maryland Computer Services Total Talk, the Echo II, and the Type 'N Talk for voice synthesis access, and Mountain Hardware's Supertalker for digitized speech announcement software. The University also acquired a Kurzweil Reading Machine during the later stages of the project.

We use large type generated by software and through closed-circuit television, specifically VisualTek, for use by print using partially seeing students.

VersaBraille is the primary braille access device we use, but we now have MicroBrailler (successor to Digicassette) from Triformation Systems. We have one of the first production models of the Modified Perkins Terminal also. We also use the OPTACON with the CRT lens.

With regard both to the microcomputers and access technology, during the duration of the project we found it difficult to keep abreast of the rapid changes in developing technology. For example, we started with the Model I, TRS-80 which was superseded by the Model III; we started with Apple II; moved to Apple II plus and Apple IIe. Both the Microbrailler and VersaBraille models changed one or more times during the course of the project. Furthermore, the highly specialized access equipment remains extremely expensive because of the thin market demand for it. Thus, the Total Talk terminal is approximately $5,000.00, cassette braille equipment ranges from about $4,000.00

to $7,500.00. An OPTACON and CRT lens costs approximately $3,000.00.

The Cranmer Modified Perkins Brailler (CMPB) is one of the newest and most significant developments in access technology for microcomputers for visually impaired persons. The fact that it became available near the end of the project period was one of the justifications for requesting a no-additional-cost extension of the project.

Project personnel have been especially interested in the development of the CMPB or "Perkie" since we first heard of its development from Dr. Timothy Cranmer, its developer. Sandy Ruconich, who served as a graduate research assistant in the project, and who took her internship in part with Dr. Cranmer at the Kentucky Services for the Blind, became intensely interested in the Cranmer Modified Perkins Brailler to the extent that she made it the focus of her dissertation. Her dissertation is entitled "The Effectiveness of Audio-Tutorial and Braille Instruction in Teaching Braille Reading Youth to Operate the Cranmer Modified Perkins Brailler as a Computer Terminal." Dr. Ruconich's dissertation project involved 12 braille reading students with no additional learning handicaps being taught to use the CMPB by braille and audiotutorial instructional manuals she developed. The braille and audiotutorial instructional manuals were exactly alike in content but differed only in terms of the medium of instruction, that is, audiotutorial versus braille. Each participant served as his or her own control in a repeated measures design. Participants were randomly assigned to

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receive the first half of the manual in one medium of instruction and the second half of the manual in the other. Criterion reference performance of information tests were administered following completion of each half of the manual. These data together with data on individual past performance, learning time, and order of presentation were analyzed to determine whether audiotutorial or braille instruction had been more effective in presenting information. Analyses of the data revealed that audiotutorial sections of the instructional manual were completed and learned significantly faster then were braille sections and that audiotutorial performance test scores were significantly higher than were braille performance test scores. Individual task performance, information test scores, and presentation order were unaffected by medium of instruction. Dr. Ruconich concluded that audiotutorial instruction enabled information to be learned more quickly and resulted in better performance than did braille instruction. This first study conducted with the Cranmer Modified Perkins Brailler is a significant contribution on access technology for microcomputers for visually impaired students, as well as a landmark study of the audiotutorial method of providing instruction.

Readers of this report may want to consult the research by Dr. Ruconich and to examine the instructional manuals she prepared in braille and audiotutorial form to assess their relative effectiveness in operating the Cranmer Modified Perkins Brailler as a computer terminal.

The CMPB now distributed by Maryland Computer Services can serve as a braille computer, as a word processing device, and as an electronic braille writing machine and printer. At a cost of $2750 it is the lowest priced means of electronically produced braille output. Not only is it the most affordable device of its kind, it is the first braille device with full-page braille capabilities and it also has the advantage of taking the commonly available and familiar Perkins Brailler and giving it expanded capabilities of electronic word processing in braille.

Previously, braille output from a computer has been limited almost completely to one-line displays of from 12 to 24 cells. This line-at-a-time and attenuated line length is a severe limitation of other electronic braille devices when used as access technology by the braille user with computer displays. Any information printed on the computer screen can be simultaneously printed on braille paper by the CMPB. This allows a braille reader to review a full page of material in contrast to the line-at-a-time from other electronic devices.

With the cable configurations shown in Appednix B, the CMPB was used in three modes in our laboratory and in workshop demonstrations 1) as an input/output device for the Apple IIe, and 2) as a braille printer, and 3) as a tactile graphics printer. Thus, as an input/output device, the CMPB can instantly provide braille access to a microcomputer. The braille keyboard of the CMPB can be used to send information to the computer without disabling the computer's keyboard. The braille printout of the full computer screen allows the braille reader to review a full page of material. Thus, this system provides a blind computer user with virtually complete access to a microcomputer even to the extent of providing some graphics.

The CMPB also functions very effectively as a braille printer. No other electronic braille printing device is available at anywhere near approximating this low price. For example, the LED 120 from Triformation Systems costs about $12,000. Using the CMPB a blind computer user can write and edit text using a voice synthesizer, a cassette braille machine, or a braille paper printout to view what has been written. When the material is exactly as the writer wants it, it can be printed out in braille on the CMPB. When used with Braille-Edit software, the CMPB enables the typist with no knowledge of braille to produce grade 2 (fully contracted) material. Any material typed on the computer keyboard can be translated into Grade II braille through the Braille-Edit software and then printed out on the CMPB. The embossing head prints both from left to right and right to left producing approximately 10 braille characters per second. While this output rate seems slow by print standards, it is reasonably fast by braille standards, and exceedingly efficient in terms of the low cost of the CMPB.

The Super Cranmer Graphics Package (SCGP) available from Raised Dot Computing is a recent addition to the CMPB which provides for its use in a graphics mode and which allows it to serve as a tactile graphics printer. No other comparable device is as yet readily available for this purpose. The graphics mode of the CMPB eliminates the spaces between braille cells and lines, thus providing a single braille dot corresponding to each pixel on the computer screen. Any high resolution image on the Apple II screen can thus be reproduced in braille dots by the CMPB. This capability constitutes a highly significant breakthrough in microcomputer access for visually impaired students. As indicated by the supplementary evaluative criteria for assessing software elsewhere in this project (see Appendix E), much software must be evaluated in terms of its reliance on graphics and may be precluded for use by visually impaired students since the means of reproducing graphics has up to now been unavailable or so extremely expensive as to be unfeasible. In our laboratory, we explored various ways of producing high resolution images on the Apple II and transmitting them to the CMPB for reproduction as tactile graphics.

Graphics can be created through line-by-line, computer user programming which is extremely effective although extensively time consuming. Graphics programming can produce impressive results but require extended study and practice before one can use them effectively. The easiest and quickest method explored in the lab was the use of the Power Pad from Chalkboard, Inc., and the similar Koala Pad from Koala Technologies Co. Both the Power Pad and the Koala Pad provide a drawing surface that plugs into the joystick receptacle of the Apple. Any line, shape, or drawing made with a stick on the drawing surface appears on the Apple screen. When the desired picture or image is complete, it can be printed out on the CMPB. The CMPB produces an exact tactile representation of the picture on the Apple screen. This capability has wide-ranging implications for blind students. Not only can maps and graphs be produced, but any picture or drawing that appears in textbooks or class assignments can now be quickly made available for blind students.

This capability opens unique opportunities for research on developing and understanding tactile representations of visual graphics. Previous research has suggested numerous problems in the interpretation of two-dimensional pictorial or graphic material when being interpreted as tactile graphic images. The capabilities for the relatively quick and easy portrayal of visual graphics in tactile forms opens immense possibilities for developing concepts relative to mobility and orientation, to the use of graphics relevant to mathematics and science, and to the maps and graphics relevant to social studies, study skills, and illustrations for texts and other instructional materials.

In addition, as the current project was drawing to a close, the principal investigator and others were beginning a project entitled "Teachers of Visually Impaired Students Can't Wait: Developing Writing and Word Processing Skills Through Microcomputers and Access Technology." The Cranmer Modified Perkins Brailler will be used in this project to help braille writing students improve their writing skills through word processing using the Braille-Edit program and the Cranmer Modified Perkins Brailler as well as other access technology devices. We believe that one of the most significant technological breakthroughs in information processing for visually impaired students is the capability for independent word processing skills made possible in part by the Cranmer Modified

Perkins Brailler and in part by a variety of other access technology.

When an IBM - Personal Computer (IBM-PC) became available to our project we developed a mini task force to intensify and accelerate our work with the IBM-PC both to achieve project goals and to provide assistance to the IBM Corporation. We aspired to achieve the same goals with IBM-PC we had with the other computers such as the Apple and earlier, the TRS-80. A unique combination of public and private interests is reflected in this endeavor: IBM, a private business enterprise; Vanderbilt, a private research university with publicly funded (U.S. Department of Education, Office of Special Education Programs) research projects; Ohio Rehabilitation Commission, a public agency; and the American Foundation for the Blind, a major private foundation working in the interests of blind persons. Several staff members participated in the IBM-PC sub-project including Mark A. Demuth who joined the staff of our project as a graduate assistant. Visually impaired himself, he is a candidate for a Master of Education degree in Special Education of Visually Impaired Persons.

Mr. Demuth has participated in this effort because of his personal and professional interest in this equipment and a unique arrangement he has with the Ohio Rehabilitation Commission and the American Foundation for the Blind in New York. He was provided funding for the purchase of his own IBM-PC to be used in its unmodified form until his failing vision (due to retinitis pigmentosa) requires him to adapt the computer or to use access technology to meet his needs. Proposed adaptations or access technology included large print readout or screen modification, synthesized voice output, and eventual input/output interface with an electronic braille device such as VersaBraille. Through pilot study, with Mr. Demuth and a second blind student, Nassir Mosa, the project has been able to learn how to make the IBM-PC accessible to visually impaired persons. It is a fortunate confluence of mutual interests which has been of benefit to blind persons, IBM, and our research program.

Following are comments derived from the pilot study:

"Project research has assisted me investigating my use of computer and access technology. Project research on large print, voice, braille, and simultanteous output for visually impaired students has been very beneficial. The demonstrations project staff provided on the equipment in the Microcomputer Lab was invaluable in making the proper descision for my microcomputer needs."

The Visualtek DP-11 large print processor which works passively with the IBM-PC and the counterpart DP-10, which works with the Apple IIe are impressive and helpful for the partially seeing person. Their capability to enlarge print from 1/4" to 6" with excellent clarity and refined composition shows great potential for large print users. The system's highly contrastive screen with the ability to "curtain" off all but the line being used is certainly an asset for many eye conditions. The variable speed control allows access to material at differing rates and allows searching for text easily. The DP-10 and DP-11 have a number of useful controls including a "home button" which returns the cursor to the upper lefthand corner of the screen at the touch of a button. They also have a cursor button which identifies the cursor's present location. The extraordinary thing is that the microcomputer isn't affected at all during any of these functions.

The IBM program PCBRAILL is a software program which enables the IBM-PC to be interfaced with the VersaBraille for the visually impaired population who must use braille as their mode of reading. It is anticipated that the work the Project has done for IBM will facilitate the release of this software to the public, as many visually impaired indivduals in the business sector as well as the increasing number of IBM-PC users in the schools and colleges could benefit from this capability.

The pilot study investigator's comment:

"My experience in using the IBM program PCBRAILL has been a very positive one. This program inaugurates an excellent working relationship between two giants in the field of technology today: the IBM-PC with its great expandability and efficiency, and the VersaBraille with its outstanding practicality, flexibility and reliability. As a blind person, I strongly believe that this program will have far reaching implications, not only for the education of the blind and visually impaired in schools, but also for the betterment of their lives in society as a whole.

Although the flow of communication between the IBM-PC and the VersaBraille throughout our pilot testing was generally effective and smooth, two minor problems, in my judgment, are noteworthy: 1) an unusual repetition of characters, such as dashes or "f's" or "n's" and 2) the VersaBraille would not display the same text displayed on the CRT screen, omitting some sentences. The pilot study suggests that these problems could have been a direct result of an improper setting of configuration control parameters."

A major component of this pilot study was to design procedures and to test the IBM PCBRAILL software program. This cooperative venture has yielded detailed procedures for interfacing the IBM-PC with the VersaBraille. (see Appedndix A.)

In pursuing our second objective, to develop and evaluate instructional programs, we have developed a three module instructional program for student use. These modules have been pilot studied in our laboratory, further pilot studied at the Tennessee School for the Blind, and subsequently placed for field study at schools and programs for the blind in Kentucky, Georgia, Nebraska, and New York. The modules are entitled, "Module One: Introduction to Operation of Apple II Plus Microcomputer System." The purpose of this module is to familiarize the student with the major components and features of the Apple II Plus microcomputer system so that the student can independently access microcomputer programs. Mastery of this module is demonstrated by passing a performance test to a criterion level of 100 per cent. "Module Two: Access Technology for Visually Impaired Microcomputers Users," provides information to visually impaired students regarding several modes of access to microcomputers. This module includes four objectives with a criterion referenced mastery test for each objective. "Module Three: Introduction to Basic Programming" introduces the computer language BASIC through an interactive program on the Apple microcomputer. In this module, the student is introduced to elementary BASIC commands and learns to analyze simple programs. The Modules appear in Appendix C.

WORKSHOP FOR TEACHERS

In pursuing our third objective, we have developed a teacher education workshop first pilot studied at the Tennessee School for the Blind and later presented in other residential and day-school programs for visually impaired students. This workshop provides an overview of microcomputer technology and current educational applications. Teachers learn through hands-on contact about the special access technology required to make microcomputers accessible to visually impaired persons. Emphasis is placed on allaying teachers' anxieties about technology and its applications in special education. An outline of the Teacher Workshop appears as Appendix F.

EVALUATING SOFTWARE

In pursuit of our objective to evaluate selected, adapted, or specially developed computer-assisted instructional (CAI) programs, we have developed a policy and set of supplemental criteria especially relevant to visually impaired students, their unique vision and learning characteristics, and the configurations of access technology best meeting their needs. These criteria are used in connection with conventional software evaluation procedures. As a matter of policy, we believe that software to be utilized with visually impaired students should first be evaluated in terms of those criteria which are relevant to the selection of quality software for any sighted student. We have adopted criteria developed by the MicroSIFT Project of the Northwest Regional Laboratory. However, there are additional criteria that must be utilized if visually impaired students are to benefit from microcomputers and software. Following are criteria developed through our project:

1. Does the software contain pictures, nonstandard characters, nonprint symbols, or other graphics, and to what extent are these essential to understanding the program and benefitting from it?

Use of some access technology devices make it difficult or impossible to convey graphic information to visually impaired users. Programs including such material need not necessarily be ruled out on this criterion, but they must be demonstrably beneficial despite this constraint.

2. Does the software present material in columnar or other unusual format and to what extent is the format of the material essential to understanding the program and benefitting from it?

Cassette braille equipment and voice synthesis devices produce material only in linear, line-by-line form. If two or more columns of material are presented or the material is presented in unusual format, it becomes much more difficult to read and understand through the devices utilized in access technology. The recently available Cranmer Modified Perkins Brailler and forthcoming AFB Tactile Graphic Display may ameliorate this problem.

3. Can user support materials be provided in braille, audio, and large-print form for the effective independent use of the software program?

Software without user support materials is often useless.

4. Does the user control the rate and sequence of presentation and review when access technology is used?

Longer examination and study may often be required by users needing access technology. Does the value of the program justify the greater time investment required?

5. Does the program use time as a constraint, i.e., quicker answers receive higher points?

The slower display of materials presented through access technology may produce a disproportionate disadvantage for the visually impaired user.

6. Are provisions made for users to save their work prior to completing the program and to restart the program at the point it was interrupted?

Access technology slows the output and extends the duration of some programs, thus stressing the need to be able to interact with the program in meaningful parts.

7. Is sound used to reinforce material visually?

Sound cues can often facilitate access to the program for visually impaired students. Also, if the program is to be mediated for visually impaired users solely by the use of voice synthesis devices, how original visual and auditory material will work with the voice synthesis mediation needs to be evaluated.

8. Can the software program and instructions be modified to include additional subroutines and can the output of the program be directed to a serial port for peripheral equipment?

The use of access equipment may be complicated by software program constraints. For example, as a protection against unauthorized copying of many software programs, the programs contain their own disk operating systems which do not permit the use of serial interfaces, editing, and listing of the source code.

9. Does the software use keyboard-entry-only commands (for example, "GET" in Applesoft BASIC or "INKEY$" in microsift BASIC)?

Input to programs using such commands cannot easily be made from devices such as cassette braille machines. Various individuals are working toward solutions to such problems, but the solutions are not yet widely and easily available.

10. Is the program reliability likely to be changed by the use of access technology?

Electronic interfacing of peripheral equipment required for access technology may change the reliability of operation of certain programs.

11. Can intended users independently use the program along with the required access technology?

The addition of access technology may make the use of a program more complex than it would otherwise be.

These criteria are being validated through us. We are continuing to seek feedback on them from users in the field. We would especially appreciate suggestions for needed additions, improvements, or alternatives.

DISSEMINATION

The fifth objective of our project is to disseminate information about access technology and microcomputers for visually impaired students and the instructional materials needed by students and their teachers to utilize them effectively. We expect to continue our research program in order to stay abreast of the state of the art in microcomputer technology and to develop the access technology required to enable visually impaired students to use microcomputers. We expect to continue to link state of the art microcomputers with access technology in the laboratory, to develop student use instructional materials designed to teach its use, and to pilot test equipment configurations and instructional materials before field testing them and evaluating them for dissemination. We also seek to identify needed competencies for teachers and students for the use of microcomputers and access technology and to develop, pilot test, disseminate and evaluate instructional and informational materials for preservice training and inservice education programs that will facilitate attainment of such competencies. We are especially eager to develop a dissemination program using such means as telecommunications, teleconferencing, and computer conferencing, along with more conventional means of disseminating information so that personnel can be effectively prepared for the use of microcomputers with visually impaired students. We have applied for funding to support a special project to achieve these objectives.

It was the U. S. Congress' intent in enacting P. L. 94-142 to "force the distribution of technology" in behalf of handicapped children according to Gilhool. Many special educators have recognized the value of technology. They apply technology to the problems of handicapped learners because they know its value and its rightness. They do not need to be threatened or coerced by law. The law's value will take courage and constant effort to close the gap between practice and the state of the art. Let's keep working at it.

OBJECTIVE 1

Objective 1: To research microcomputer systems to be made accessible to blind youth through print, voice, and touch (new versions of cassette braille recorders and OPTACON tactile print).

The review of existing equipment, both microcomputer equipment and access technology, was the essential foundation for implementation of this project. Attainment of all other project objectives relied on information generated through laboratory experience with equipment reviewed by project staff. For example, as new equipment and information became available it was included into the work presentations (Objective 3) and considered for inclusion in student instructional modules (Objective 2). The constraints placed on selection and evaluation of software were also determined through laboratory and pilot study experience with the equipment gained in the microcomputer laboratory and field test sites as part of Objective 1 activities. Thus, review and pilot study of equipment within the microcomputer laboratory was critical to the success of this project.

In order to facilitate the review of equipment, a small microcomputer laboratory was established. The laboratory housed examples of various microcomputers as well as the access devices and necessary interfacing hardware. In this way, various combinations of access devices with microcomputer equipment from different manufacturers could be established and reviewed. A complete listing of equipment used in the project is contained in the equipment section. In addition, the microcomputer laboratory served two other purposes. First, it was the primary site for demonstrations, seminars, and other dissemination efforts. In addition, the microcomputer laboratory also served as a source of technical expertise for the assistance of on-site personnel who need information, advice, or who were experiencing equipment difficulties. The microcomputer laboratory served both to generate new knowledge and to maintain the ongoing efforts to attain the project objectives.

One of the major types of information sought through activities at the microcomputer laboratory were the features, advantages, and strengths and the limitations and weaknesses of various access devices. This information was obtained through use of the devices in combination with a number of brands of microcomputers and with a range of available and accessible software. Information regarding the advantages and limitations of access devices was also obtained from teachers and students at participating field test and evaluation sites (see Objective 2). Table 1 contains a listing of the advantages and limitations of various access equipment as determined by project personnel and those who cooperated at the field test and evaluation sites. This information also became an essential part of the material presented in the workshop for teachers (Objective 3). (See Appendix F).

Many of the identified advantages of the access equipment listed in Table 1 are complementary. The multimedia approach taken by this project was inspired by this finding. For example, both the VersaBraille cassette braille recorder and the Echo II voice synthesis system are frequently inadequate for accessing information displayed in a multi-column format. The Optacon, on the other hand, quite readily allows the versatility of searching columns by the capable Optacon user. However, Optacon reading speeds are usually quite slow: braille reading speeds with VersaBraille and, especially, speech recognition speeds are considerably faster. This brief example makes it clear that any single mode of access, considered alone, is typically incapable of meeting all the varied needs of a visually impaired microcomputer user. However, when seen as complementary components of a multimedia access system, these devices can provide access for a wide range of users to a wide range of microcomputer-based materials. Thus, a beginning is made to provide visually impaired students access to microcomputers that is roughly equivalent to that of their sighted peers.

Figures 1 through 17 contain the interface cable configurations and interfacing notes for the microcomputer equipment and access devices used in the microcomputer laboratory. This information represents a subset of the possible cable configurations that might be required when considering all possible combinations of microcomputers and access devices. This is discussed further in the next sections.

Changing Technology--A Solution to the Problem

The largest constraint on a project such as this, which seeks to gain an understanding of existing (shelf stock) high technology devices, is simply this: by the time the information is acquired and presented in a disseminable form, the technology has changed or is in the process of changing. This constraint manifested itself in many ways with regard to project efforts. One particularly noteworthy example can be shown in the case of the Microbrailler cassette braille recorder, manufactured by Triformation Systems. At the beginning of this project in the Fall of 1981, most of the equipment necessary to establish the microcomputer laboratory was ordered. At that time a DC-20M (the then-current version of cassette braille recorder) was ordered from Triformation Systems as an access device. It was not until late in the first year of the project (Fall 1982) that an entirely different model, a Microbrailler, model MB-2400 was shipped to the project. This was not the device ordered, but a newer replacement. A decision had been made by Triformation Systems that the newer device would be far superior and more reliable, so the DC-20M was never shipped. A letter from Triformation Systems is included documenting this problem (see Appendix I, Nelson letter of May 13, 1982).

Since the Microbrailler cassette braille recorder was not delivered until late in the first year, it was not included in the initial development of either the student introductory modules (Objective 2) or the teacher workshop materials (Objective 3). Activities in the second year of the project allowed information about the Microbrailler to be included in updates of these materials, and the Microbrailler was evaluated in the microcomputer laboratory, resulting in its inclusion in the

Figures 1-17 summaries of interfacing cable configurations.

The VersaBraille from Telesensory Systems also underwent a revision during the course of this project. The VersaBraille Model P2C software was enhanced in early 1983. A letter from Telesensory Systems, Inc. is included to document the changes (see Ehlers letter of May 27, 1983). These changes were trivial in comparison to the release of an entirely new device; however, they did complicate attempts to document precise steps for the accomplishment of interfaces between specific microcomputers and access equipment.

Due to the changes cited above, comparisons between the cassette braille devices were hampered. While comparisons were made using microcomputer laboratory facilities, an in-depth analysis was not a planned part of year-two activities. Therefore, a comparison of the two devices supplied by Telesensory Systems as a result of a written inquiry is included (see Appendix I, Telesensory Systems letter to Nassir Mosa, March 28, 1983). It is important to note that this document was prepared by the manufacturer of one of the devices, the VersaBraille, clearly not a disinterested party. However, it is included in lieu of more objective and complete information.

The problem of changing technology not only affected the equipment acquisition efforts of the project, it had an impact on all aspects of project efforts. For example, student instructional modules developed in connection with Objective 2 of this project were rendered incomplete by the development of the new VersaBraille software and the availability of the Echo II voice synthesis system. Teacher workshop materials developed in connection with Objective 3 of this project also required continual updating throughout the project to reflect new products and changes in older models. When the simultaneous changes in microcomputer technology are also considered, giving complete and explicit interfacing information became the concern for an ongoing information clearinghouse, rather than a research topic.

This lead to the development of an alternative strategy for presenting the findings from microcomputer laboratory activities. Rather than attempting to document the exact strategies for every possible combination of microcomputer and access device (on a continuing basis), information requirements and the necessary technical information was compiled. This information is presented in the next section, a summary of the issues of interfacing. It is designed to be read by teachers with little or no experience with computer hardware. An effort was, therefore, made to eliminate technical jargon and technical writing from this section.

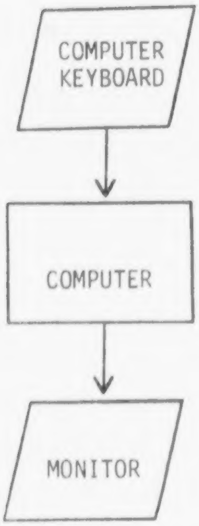
Interfacing Braille and Voice Terminals with Microcomputers

The ability of a computer to communicate with other electronic devices is essential for providing braille and voice output. Without this communication the computer could not print the results of its computations or store our data. The most common applications of this capability are seen in the transfer of information within the computer system itself; from the computer to output devices such as the monitor, disk drives and printer, and to the computer from input devices like the keyboard and disk drives. A computer can even be controlled at a distant location by sending signals from an alternate keyboard through a telephone system. This capability to communicate with other devices is critical for access by the visually impaired. If we substitute a braille keyboard for the typewriter-like keyboard of the microcomputer, or if large print, braille, or spoken-word output are substituted for the monitor's characters, we can harness the built-in communication system of the microcomputer to provide access for the visually impaired.

Anyone attempting to install a braille or voice device as an alternate means of input or output to a microcomputer, must address two separate issues: first, rerouting the normal flow of information within the system to the added device, and second, matching the computer's requirements for data transfer to those used by the input-output device being attached. Since new microcomputers are being introduced daily and existing systems are constantly being updated, it would be impossible to give exact instructions for all systems. Therefore, a general description of the system configuration and a list of things to consider when setting up such a system is provided. Sample commands and parameters are included for popular microcomputers.

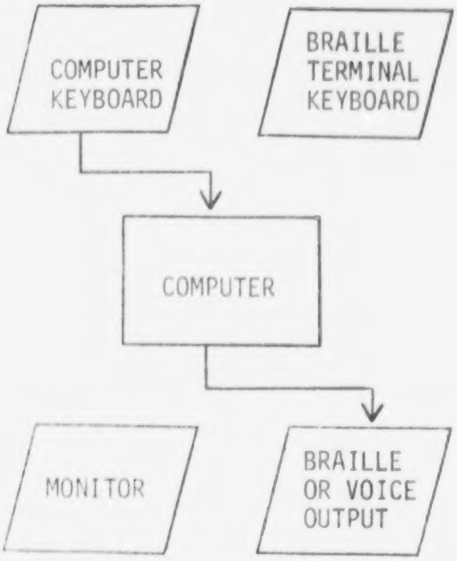
Rerouting the Normal Flow of Data

In a typical configuration, the communication necessary for operation of a microcomputer consists of messages to the user or operator displayed on the monitor and instructions to the computer typed on a keyboard much like that of a typewriter (see Figure 1).

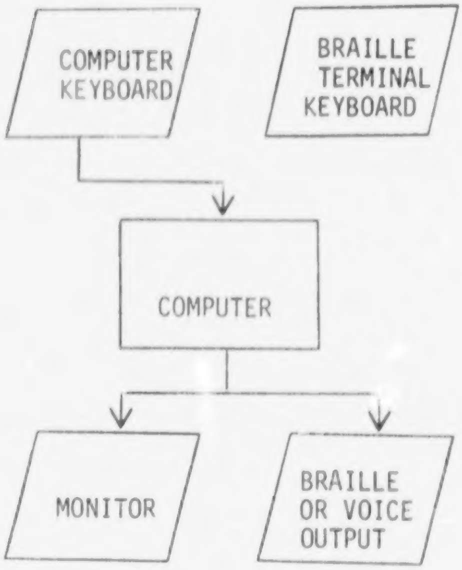


1. TYPICAL INPUT/OUTPUT

In order for the microcomputer to be completely and independently accessible to the visually impaired user, all communication from the computer must be rerouted to, or duplicated on, a terminal which provides braille or voice output (see Figures 2 and 3). When output is rerouted, transmission to the monitor is discontinued. When output is duplicated, it is sent to both the monitor and terminal.


COMPUTER KEYBOARD
BRAILLE TERMINAL KEYBOARD
COMPUTER
MONITOR
BRAILLE OR VOICE OUTPUT

2. REROUTED OUTPUT


COMPUTER KEYBOARD
BRAILLE TERMINAL KEYBOARD
COMPUTER
MONITOR
BRAILLE OR VOICE OUTPUT

3. DUPLICATE OUTPUT

In performing its activities, the computer follows a set of instructions in a program called an operating system. These instructions define commands which can be given by the user to the computer. Some common examples of these commands are LOAD, RUN, and SAVE. Often the operating system will contain a command or commands which allow the user to reroute or duplicate output sent to the monitor on a printer in order to have hard-copy of the screen's contents. If the operating system of a microcomputer contains such a command, it can also be used to direct output to a braille or voice terminal. Although many microcomputers have partial voice output, not all of them have the capability of rerouting all of the output. Therefore, a visually impaired user would listen to the output of a specially prepared program, but would have no way of operating the computer completely by himself since he could neither verify the accuracy of his input nor read

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the responses of the computer, such as file directories and error messages because they were not prepared for by the specially designed program.

- In the Apple II Plus and Apple IIe microcomputer systems, this command takes the form of "PR#n" where n represents the number of the Apple's slot in which interface hardware is installed. The braille or voice terminal is plugged into this hardware. Whether the output will be rerouted or duplicated depends on the interface hardware used.

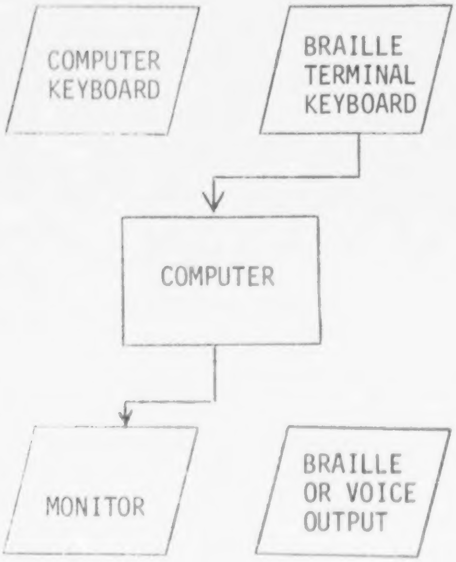
- In the LDOS Operating System available from some TRS-80 Microcomputers, the "LINK" command will duplicate output and the "ROUTE" command will reroute output.

- The IBM Personal Computer duplicates all output to both the screen and the parallel printer after the user presses "P" while holding down the "control" key. A second step is then required, in which the "COM" command is used to reroute the parallel printer output to the voice or braille terminal.

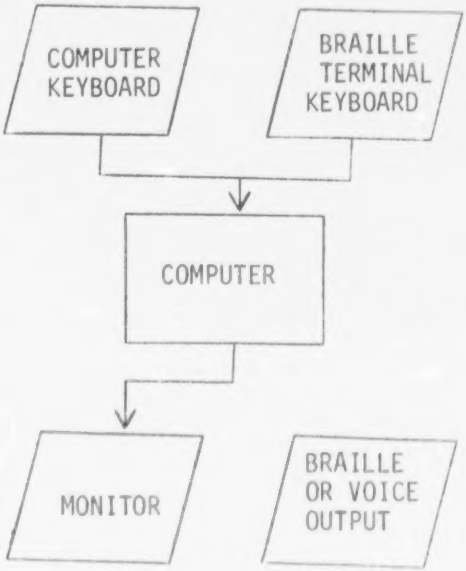
- Microcomputers utilizing the CP/M Operating System often make use of the "CTTY" command which stands for change terminals. After giving this command all output is rerouted to an alternate device which must have a keyboard to respond as well as a display to read.

Input - An Additional Concern

In the case of a braille terminal it is often desirable to use the Perkins-style keyboard of the terminal as a means of input. To accomplish this the computer must be instructed to anticipate input from a keyboard other than its own. This type of command is less commonly found than the "duplicate" or "reroute" output commands.


COMPUTER KEYBOARD
BRAILLE TERMINAL KEYBOARD
COMPUTER
MONITOR
BRAILLE OR VOICE OUTPUT

4. REROUTED INPUT


COMPUTER KEYBOARD
BRAILLE TERMINAL KEYBOARD
COMPUTER
MONITOR
BRAILLE OR VOICE OUTPUT

5. DUPLICATE INPUT

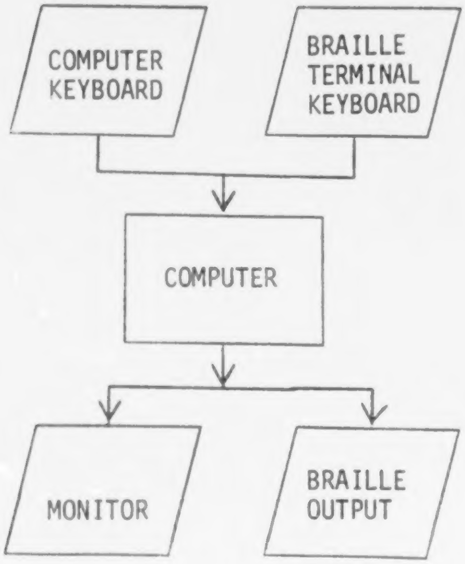
Some popular microcomputer systems in which "reroute" or "duplicate" input commands can be found are as follows:

- In the Apple II Plus and the Apple IIe microcomputers the command "IN#n", where n represents the number of the slot where the interface hardware is located, prepares the computer to receive information from another keyboard. The braille terminal is plugged into the interface hardware. Whether or not this command disables the computer's keyboard (rerouted input), depends on the type of interface hardware used.

- The LDOS Operating System's "LINK" and "ROUTE" commands allow the use of an alternate keyboard for input to some TRS-80 microcomputers.

- The "CTTY" command found in the IBM Personal Computer's Disk Operating System Version 2.0 requires the use of an alternate keyboard since input is rerouted and the IBM's keyboard is disconnected. Unfortunately, this command is not compatible with programs written in BASIC.

When two people, one of them visually impaired, are working simultaneously with the same computer, it is important that the modifications made to the microcomputer system in order to attach the access device do not disconnect either the monitor or the keyboard of the computer. This duplicate input/output system should be selected if it is available.



6. DUPLICATE INPUT AND OUTPUT

Preferred for braille terminals

- Some interface hardware for the Apple II Plus and the Apple IIe which provide duplicate output to the monitor and a terminal are the Apple Serial Interface Card (A2L0008), the Apple Communication Card (A2B0003X), the California Computer Systems Serial Interface Model 7710D and the Apple Super Serial Serial Card. Examples of interface hardware which do not disconnect the Apple's keyboard when the braille terminal is initialized (duplicate input) are the Apple Serial Interface Card (A2L0008) and the Apple Super Serial Card.

- The "LINK" commands in the LDOS Operating System for the TRS-80 allow duplicate input and output.

Microcomputers other than those mentioned may have similar commands to reroute output and allow alternate input. Consult the Operating System manual or a sales representative for these computers.

Protected Software - A Major Problem

Perhaps the most difficult problem in rerouting the normal flow of information within the microcomputer system, is that of protected software, programs which use operating systems with no user commands. Computer piracy is the unauthorized copying of copyrighted computer programs. Because the operating systems that are supplied with microcomputers provide commands for copying programs, it is very simple to borrow or buy a program, make a copy, and return the original. Software companies in order to protect themselves against unauthorized duplication of programs often supply a unique operating system with their programs. There are no "copy" commands with these systems, and also no "duplicate" or "reroute" commands. At present, it is almost impossible for a visually impaired computer user to gain access to these programs.

Matching the Requirements for Data Transfer

Before attempting to connect a braille or voice terminal to a microcomputer system, one must determine if the two devices are compatible. Even though most microcomputers have similar components such as monitors, keyboards and disk drives, and can be programmed in the same languages such as BASIC, PASCAL, and FORTRAN, there is as much diversity in their design and features as there is in different makes of automobiles. It should be remembered that interfacing is a one time process for each pair of devices. Therefore, it is not necessary for each computer user to become an interface expert. Since the use of braille and voice terminals is not often encountered by the average computer dealer or technician, the following information may be helpful in establishing one's own system or communicating one's need to a consultant.

The easiest type of device or peripheral to attach is one which has been designed to work with the specific microcomputer which one will be using. In this case, the manufacturer will have preset the peripheral to match the basic requirements of the microcomputer and can provide an appropriate cable and software, if necessary. The user is responsible for determining if his/her microcomputer system contains the options required by the access device. Typical options would be one or more disk drives and a minimum amount of "RAM" memory.

- The ECHO II Speech Synthesizer is designed to plug into a slot in the Apple II Microcomputer and comes with a software support package that converts the text displayed on the monitor to speech. The software also includes features which verbally echo the key being pressed and allow the user to repeat any text displayed on the monitor. The ECHO II requires a disk drive.

- The Speech Master and Speech Master Software Support Package are designed to produce synthetic speech output for the IBM Personal Computer and include features similar to the ECHO II.

- The Mountain Hardware SuperTalker and the Ufonic Voice System provide both software and hardware which allow the Apple

II computer to control the playback of digitized human speech. These systems require a disk drive.

- Maryland Computer Services manufactures the Information Thru Speech computer system which includes built-in synthetic speech output and an optional braille display.

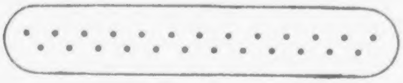
In contrast to these examples of voice output devices which are designed for use with a specific microcomputer system, there are output devices and terminals which are standard methods of sending and receiving data and can communicate with a wide variety of microcomputers. The most widely used format is Revision C of the RS-232 standard adopted by the Electronic Industries Association (EIA). This standard defines the format in which the information or data is sent, the type of signals sent over telephone lines or through cables, and the type of connector used for coupling the equipment. (It is possible to connect devices with less common protocols than the RS-232-C through the use of converter units; however, that is beyond the scope of this report.)

- The hardware and programs necessary for the RS-232-C interface or linkage are often optional equipment on microcomputers, but since they are used for attaching printers to microcomputers, they are widely available.

- Some examples of electronic voice and braille equipment available with a RS-232-C interface are the Votrax Type-N-Talk, the VersaBraille from Telesensory (interface optional), the Microbrailler and the LED-120 from Triformations, and the Total

Talk and Cranmer Modified Perkins Brailler from Maryland Computer Services.

When considering an RS-232-C interface, it must first be determined that both the microcomputer and the peripheral or access device have the necessary hardware and software. Often the presence of a standard 25-pin type D connector on a device is an indication that this hardware is in place (see Figure 7).



7. 25-PIN TYPE D CONNECTOR

Otherwise, check with the dealer or manufacturer concerning the availability and installation of the hardware.

Next, the parameters must be matched so that the microcomputer and the peripheral agree on the type and format of the signals and the speed at which they will be sent. This is often done by setting switches on each device. (It is sometimes necessary to open the case of the equipment in order to set these switches. Be certain the power is turned off before doing this.) Some equipment may not provide a method for altering these signals. If a number of peripherals are to be used with one system, it would be preferable to adopt a standard, normally the configuration of the least flexible piece of equipment. Once all equipment is set to this standard it will not be necessary to change them again.

Finally, a cable must be selected to join the two pieces of equipment. Connectors are selected after determining the gender of the plugs on the two devices. It is not always necessary to connect each of the 25 pins on the two connectors. One would usually begin with pins 2 and 3 of one plug connected respectively to pins 2 and 3 of the other plug. If no data is transmitted with the wiring, cross these two wires, connecting pins 2 and 3 of one plug with pins 3 and 2 of the other. In many cases these two wires will be sufficient. In the case of voice devices or very slow printers, it will be necessary to connect other pins (pins 4, 5, 6, and 20 are most often used) in order to slow down the output of information from the microcomputer. The use of busy signals to control the flow of data is called handshaking. The construction of these cables requires the ability to solder, trial and error, and thoroughly study the documentation accompanying the two devices. If possible, have a local computer dealer construct the cable.

Typical Problems of Interfacing RS-232-C Equipment

1. PROBLEM: No data appears to be transmitted.

SOLUTION: First connect pins 2 and 3 on the connector of the transmitting device. This process is called shorting and will cause the device to transmit to itself. This is a test to determine if the device is actually sending data. Transmitted data should then appear on the display of the transmitting device. If not, check the commands and hardware of this device. If the device will transmit data to itself, reconnect the two devices and swap wires 2 and 3. If there is still no transmission, check the handshaking requirements of the receiving equipment.

2. PROBLEM: Transmission occurs, but the characters received are not correct.

SOLUTION: Match the "baud" rate or rate of transmission on the two pieces of equipment.

3. PROBLEM: Transmission occurs, but some of the characters received are not correct.

SOLUTION: Match the parity, data length and stop bit parameters on the two devices.

4. PROBLEM: First characters are received, then equipment freezes and will not respond to its keyboard.

SOLUTION: Receiving device is sending a busy signal or transmitting device is not receiving a ready signal. Check the handshaking signals.

5. PROBLEM: Characters are missing in the body of the transmission.

SOLUTION: Receiving device is signaling busy and sending device is continuing to transmit. Check the handshaking requirements.

6. PROBLEM: Characters on ink-print or hard-copy braille output are missing at the beginning of the line.

SOLUTION: The time necessary to return the carriage is causing the printer to miss transmission. Slow down the rate of transmission, add a delay following the carriage return, or check the handshaking requirements.

7. PROBLEM: Two of every character appears. (EExxaammppllee)

SOLUTION: Change the duplex parameter from half to full.

8. PROBLEM: Character is received, but is not displayed on the transmitting device.

SOLUTION: Change the duplex parameter from full to half.

Connecting a braille or voice terminal to a remote computer via telephone lines requires the addition of another piece of hardware called a modem. This device translates the signals understood by the microcomputer or access device into tones that can be sent over telephone lines. The modem is either plugged directly into the telephone line (direct-connect type) or the handset of the telephone is fitted into the modem (acoustic type). Some access devices such as the VersaBraille and the Total Talk can be attached directly to the modem. Special provision must be made to attach both a braille or voice terminal. One method of accomplishing this is the use of a modem with two RS-232-C connectors or a "Y" cable.

Since both the microcomputer and the braille and voice terminal market are changing rapidly, it is best not to assume that any two pieces of equipment are compatible. For example, even if both your microcomputer and voice terminal have RS-232-C interfaces, you might find that when you attempt to connect them, the microcomputers RS-232-C hardware does not respond to the voice terminal's busy signals and much of the transmission is lost. Therefore, it is advisable to always test the compatibility of the interface before investing in the equipment

Table 1

ADVANTAGES AND LIMITATIONS OF VARIOUS ACCESS DEVICES

Cassette Braille Devices

Advantages:

1. Both input and output in braille (single medium)
2. Allows storage and review (not in Grade II)
3. Accurate character representation (vs. voice)
4. Speed faster than OPTACON

Limitations:

1. One braille line (no search capability)
2. Expense
3. Weight
4. Only Grade I
5. Ignores graphics
6. Slower than voice or regular braille
7. No widely accepted Computer Braille Standard
8. Tapes not interchangeable

OPTACON

Advantages:

1. Full-screen search capability
2. Paper and screen-based output can be accessed
3. Does not alter mode of program delivery (graphics remain)

Limitations:

1. Bi-manual coordination
2. Slow reading speeds
3. Requires additional reading medium skills
4. Provides output only

Speech Synthesis

Advantages:
1. Rapid reading rate
2. Braille skills not required (broader users pool)
3. Attempts all output
4. Unlimited vocabulary

Limitations:
1. Low speech quality/mispronunciations
2. No search/review capabilities
3. Ignores graphics
4. Output only

Digitized Speech

Advantages:
1. Excellent quality speech
2. Can enhance with inflection, accents, and expression

Limitations:
1. Small selected vocabulary
2. Must have software, cannot access all micros/programs
3. Each program must be modified
4. No search or review capability
5. Ignores graphics

Large Print

Advantages:
1. Serves largest portion of visually impaired population
2. Does not effect mode of program delivery (graphics remain)

Limitations: 1. Hardware - single size

2. Software - requires program modification

General Limitations

1. Require additional start-up procedures

2 Require initialization of peripherals through DOS (operating system command)

OBJECTIVE 2

Objective 2: To develop and evaluate instructional programs for teaching visually impaired youth to use microcomputer systems through multimedia access.

The primary purpose of this project was to demonstrate that the many benefits of microcomputer use could be extended to school-age children who have visual impairments, including those who are severely visually limited or totally blind. These benefits included the use of microcomputers as a source of leisure time activity, as a means of instruction, and as an aid in home management (i.e., budgeting and banking). Another potential benefit of the use of microcomputers was that they could serve to familiarize visually impaired students with the growing number of career opportunities in computer-related fields. In order to demonstrate that visually impaired students can gain access to these potential benefits of the use of microcomputers, students must first be trained to independently use the microcomputers. Such training requires valid systematic instructional materials to aid teachers in instructing visually impaired students on the use of the microcomputers and required access equipment. It was the objective of this project to develop instructional materials to meet the need.

Toward the goal of training visually impaired students to become familiar with the operation of the Apple II Plus microcomputer, and in conjunction with completion of Objective 2 of this project, a three module set of instructional materials was developed by project staff. This training package was developed to provide teachers and other professionals with a systematic means of introducing students to operating and programming microcomputers, and to acquaint both teachers and students with their educational, vocational, and avocational uses. (Final drafts of the Module One, Two, and Three printed materials as well as the Module Three program diskette are available in Appendix C.)

Description of Modules

(The Modules are found in Appendix C)

The microcomputer training package developed by project staff was organized into three modules, reflecting a continuum from basic skills in the operation of the microcomputer to introductory level programming skills requiring proficient use of one or more access devices. Module One provided students with an introduction to the fundamentals of microcomputer operation, and enabled students to gain an idea of the uses to which microcomputers could be put. Module One emphasized the procedures required to get the microcomputer operating, rather than a conceptually sophisticated understanding of exactly how the microcomputer worked. It was written at a level appropriate to allow visually impaired students to use the microcomputer independently and without assistance from sighted readers. The first part of Module Two was a brief general introduction to the possible means of access and associated access equipment. In this way after completion of the general introductory objective

(Objective 1), the teacher and student together could decide on the best device or combination of devices for allowing each student access to the microcomputer. Following the general introduction to all types of access equipment were individual objectives which trained students in the proper use of particular types of access equipment. While all students completed the general introductory objective (Objective 1), the decision on which access devices would be learned (and, thus, which of the device-specific objectives would be completed) was left to the teacher, in consultation with the student when appropriate. The device-specific objectives contained in Module Two included objectives for: the VersaBraille Model P2B (a cassette braille device), with notes for the VersaBraille Model P2C; the Optacon with CRT lens attachment; the Votrax Type-N-Talk (a voice synthesizer), with notes on the Echo II voice synthesizer; and the general introductory objective contained brief descriptions of methods for producing large print from the microcomputer's screen output.

Module Three focused on teaching the student the BASIC (Beginner's All-Purpose Symbolic Instructional Code) language through an interactive microcomputer-based program. Module Three served a two-fold purpose. First, it achieved the obvious instructional benefits of introducing students to a widely accepted computer programming language. But in addition, because Module Three was a computer-based interactive program, a student's successful completion of the module also demonstrated that the student could achieve educational benefits from computer-based materials through whatever means of access had been developed by Module Two activities.

Module Three was divided into three subobjectives focused on the introduction of the BASIC language, each a separate computer program contained on a program diskette which accompanied the first two printed instructional modules. The first subobjective introduced five elementary computer concepts: a computer language, a line number, a variable, an arithmetic expression, and punctuation systems. The second objective introduced six BASIC programming statements: Print, Remark, Let, End, List, and Run. The third subobjective introduced students to three additional BASIC statements: Goto, If . . . Then, and Input. As stated earlier, in accessing Module Three materials the students demonstrated mastery of both Module One computer-related procedures and Module Two access technology-related procedures. In this way Module Three accomplished its two-fold purpose of introducing new material while requiring demonstration of mastery of previously introduced material.

A decision was made that direct "communication" between the students and the microcomputer was important from the beginning of training; and thus, it was suggested to all teachers using the modules (and is stated in the modules materials) that programs and access devices which allow the student to work without a reader be used starting with Module One. It was acknowledged that some students might require the assistance of the teacher in typing their responses to the questions asked during a particular game, and that initially some students might also require assistance in activating the voice synthesizer. But in most instances the initial activation of a voice synthesizer was sufficient to allow immediate communication between the microcomputer and the student, and it was strongly recommended that this begin immediately with Module One activities.

Intended Audience

It was expected that many users of this training package would have a working knowledge of the operation of the Apple II Plus or other microcomputers. For teachers unfamiliar with the operation of the microcomputer equipment and its potential usefulness as a teaching and recreational tool, it was recommended that Modules One and Two be read by the teacher prior to the introduction of the student to the microcomputer. This oriented the teacher to the operating procedures of the equipment, and gave the teacher an idea of the types of microcomputer software available so that software programs which would have the greatest appeal for the students could be selected by the teacher. This prior exposure also helped the teacher to know how to correct errors which might occur as the student learned the procedures of operation.

Evaluation of Student Mastery

Each Module consisted of step-by-step procedures for each objective followed by a standard mastery test. Mastery of the material in each Module was measured by testing the student to determine if he/she had reached criterion on the mastery test(s).

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Criterion for completion of each mastery test was a score of 100%. Students were allowed to retake each test as many times as necessary to reach criterion. It was recommended that the entire test be given each time, not just the items which were failed in previous testings. Instructions for administration of the tests were provided on the test forms.

Prerequisite Skills Required for Students

For students with no prior microcomputer experience it was suggested that individual instruction be given during Module One. The level of materials contained in Module One were selected to be appropriate for pre-literate children. Modules Two and Three assumed that the student had a greater level of reading, computational and conceptual skills; thus, the teacher had greater flexibility in selecting the format of instruction. Copies of these materials could be given to the student to read and could be used in Modules Two and Three to guide students in self-paced instruction or as a means of review prior to taking the Mastery Test. It was also possible to allow groups of students to work together during Modules Two and Three. The nature of Module Three material required both a higher level of intellectual functioning as well as an interest in becoming familiar with a programming language. Module Two and Three assumed that the students typing skills were as least at the "hunt and peck" level, but no other assumptions were made about prior experience, achievement levels, or intellectual abilities of students.

Evaluation of the Modules

Procedure

A field test and evaluation of the three-module set of instructional materials was conducted beginning in the Fall of 1982. This evaluation was formative and, thus, the final edited version of the modules that is contained in Appendix C is not identical to the version of the modules that was evaluated. Comments and suggestions were obtained from both teachers and students throughout the field testing and evaluation time and related changes are reflected in the current version. A Modules packette containing the original Modules One, Two, and Three printed materials and the Module Three program diskette was sent to five participating sites (each in a different state) along with the necessary equipment to implement the training package--some sites were completely equipped through the use of loaned equipment while others had acquired all the necessary equipment completely independently of this project. The sites that participated in the field test and evaluation were: the Tennessee School for the Blind, the Nebraska School for the Visually Impaired, the Kentucky School for the Blind, the New York Institute for the Blind, and the DeKalb County, Georgia, Public Schools Program for Visually Impaired Students.

Teachers at all but the New York Institute site received a one-day workshop on microcomputers and access equipment (see Objective 3), but the Nebraska workshop was not conducted until late into the field testing period. The workshops for the other three sites were given prior to the initiation of the Module's field test and evaluation. This evaluation was also conducted in conjunction with dissertation research by a Peabody College graduate student, LaRhea Sanford, who conducted teacher orientation meetings at two of the sites prior to the start of the field test and evaluation. In addition, three reliability checks were conducted throughout the field test and evaluation in connection with Ms. Sanford's dissertation activities.

Participating Students

Across all sites, thirty-four visually impaired students participated in the field test and evaluation of the modules. Table 1 contains a complete description of these students including the nature of their visual impairments. It is clear from Table 1 that the majority of the students were male (79%), ranged in age from 12 to 21 (with a mean of 16.4 and standard deviation of 2.31), and represented a wide range of visual impairments. As shown in Table 2, all participating students had at least some typing skills (at the "hunt and peck" level), 19 had at least some braille reading skills, only 15 had Optacon reading ability, 10 had experience working with the VersaBraille prior to beginning Module Two, and 19 (56%) reported having had at least some microcomputer exposure prior to beginning their work with the modules.

Participating Teachers

In the five field test sites a total of 10 teachers participated in the field test and evaluation of the Modules, one of whom did not return a background questionnaire; therefore, there are 9 teachers on whom background information is reported in Table 3. As shown in Table 3, five teachers reported having had no microcomputer training prior to attempting to use the modules, three teachers reported having never operated a microcomputer before, three were unfamiliar with the VersaBraille cassette braille recorder, and one was unfamiliar with the Optacon.

Results of Modules Evaluation

Thirty four students completed both the pretest and posttest. However, the data returned on 6 of these students were excluded because of doubtful interpretability. Thus the pretest/posttest analyses were completed based on 34 participants, while data directly concerning number of modules completed, and trials to complete are summarized for 29 students. The summary of the six pretest/posttest questions for teachers and associated mean responses (on a scale of 1 to 5, with 5 being strongly agree) are shown in Table 4. As shown in Table 4, teachers' initial (pretest) responses were extremely favorable (4.82 on a 5 point scale). Yet, there was a significant increase in their responses from pretest to posttest, $t(17) = 1.832$, $p < .05$, to a mean of 4.98 on a 5 point scale. This suggests that as teachers' ability to use microcomputers with their students was enhanced through the use of the instructional modules, their attitudes toward the use of microcomputers in education were made more positive.

All of the 29 students completed Module One of the procedures for operating the Apple II microcomputer. As shown in Table 5, it took an average of 1.28 trials for these students to obtain 100% on the performance test for Module One. Four students failed to advance to learning how to operate necessary access equipment (Module Two activities). It took an average of 1.44 trials for the remaining 24 students to complete the general introductory objective (Objective 1) of Module Two. The number of students attempting the equipment-specific objectives of Module Two (Objective 2 through 4) and their associated mean number of trials to obtain criterion are displayed in Table 5. Table 5 also displays similar data for the students that attempted introductory BASIC programming (Module Three) activities.

A pretest/posttest analysis was also conducted on the responses from participating students to a nine-item questionnaire very similar to that administered to participating teachers. The results of this analysis are shown in Table 6. Again the initial responses were very positive averaging 4.62 on a 5 point scale (with 5 defined as strongly agree). While the responses showed an increase of one-tenth of a point from pretest to posttest, trending in the direction, this difference was not significant at the .05 level [$t(67) = .7144$, $.05 < p < .25$]. These findings suggest that students could be taught through the use of the modules and that students' initially highly positive attitudes toward the use of microcomputers in education tended to increase through their use of the modules materials.

Discussion

The three module set of materials developed by project staff is designed to systematically introduce visually impaired youth to the use of microcomputers and required access devices. It is felt that formative evaluation efforts have produced a valid instructional program that can be widely used by teachers of visually impaired youth. Further, evaluation findings reveal that both teacher and student attitudes toward the use of microcomputers in education are increased or maintained at a very high level. This, in addition to consideration of the diversity of students who benefitted from the use of these instructional materials, provides a basis for suggesting that this set of instructional modules, introducing the use of microcomputers, associated access equipment, and introductory BASIC programming, represent a valuable tool for teachers of visually impaired students who wish to train their students in the use of microcomputers.

Braille-Edit Instructional Module

(The Module is found in Appendix D)

A task undertaken as part of the grant extension was the development of an instructional module to introduce readers of braille to the Braille-Edit word processing program. Braille-Edit was designed especially for blind users and, therefore, it possesses characteristics that make word processing more efficient for individuals using braille as a primary mode of communication. However, the current documentation is designed to be used primarily by older individuals with an extensive background in microcomputers. For blind students in elementary and secondary schools,use of the documentation to learn the basics of Braille-Edit would be very complex and difficult. Since no instructional materials are currently available, this project sought to develop a module to introduce children to the fundamentals of using Braille-Edit for word processing.

Braille-Edit is a versatile word processing system allowing blind users a variety of input and output options with the Apple microcomputer. It can be used in conjunction with the Echo II speech synthesizer, VersaBraille system, Cranmer Modified Perkins Brailler,or MicroBrailler. Also, information can be inputted with the regular keyboard or with a "Perkins-style keyboard" in which six keys on the bottom row are designated as the six keys on a braille writer. Braille-Edit allows regular text to be translated automatically into Grade 2 braille. There is also a reverse translator that enables the user to translate a Grade 2 file into Grade 1 and then print out on a regular printer. Files can be printed in braille with the LED-120, Modified Perkins, or other common braille printers. Braille-Edit has a number of text editing features, including the capabilities to delete, insert, rearrange blocks of text, globally replace, and locate strings of text. There are also a variety of word processing format options, such as centering, double spacing, changing margins, automatic page numbering, setting tab stops, and underlining. Given this brief description, it is easy to understand both the great usefulness and flexibility, but also the complexities of the Braille-Edit word processing program.

The goal was to introduce, sequentially and systematically, skills in using Braille-Edit in a manner that would allow naive learners to acquire the most important and functional operations initially, without being overwhelmed by the complexities of the word processing program. A preliminary outline was prepared which presented a scope and sequence of those skills to be introduced. Following internal review of the outline, a draft of the instructional module was written paralleling the three modules already developed in the project. Parts of the module were then sent to Ms. Phyllis Brunken, a field reviewer at the Nebraska School for the Visually Handicapped, for her comments and suggestions. A draft copy of the prepared module is presented in Appendix D and is briefly described below.

Given the number of input and output options available to the user of Braille-Edit, it was decided to focus attention initially on using the regular keyboard for input and the Echo II speech synthesizer for output. This is a popular combination since Echo II is very reasonably priced in comparison to other access devices. The first section of the module is an introduction to Braille-Edit which discusses the purpose of word processing, the prerequisite skills needed, equipment, input/output options, and general vocabulary related to the system.

The next main section moves the learner deliberately and sequentially through the steps required to write and save a file, to translate the file into Grade 2 braille using the Grade 2 Translator, and then to print the file. The steps are described in detail and then reviewed in an outline form. It was decided that this entire lesson would provide the learner with the essential steps in word processing while giving immediate reinforcement through having his/her first file printed immediately.

After mastering these fundamental steps, the student is then introduced to beginning editing features with Braille-Edit in the next section of the module. These features include simple cursor movements, deleting and inserting information, and using the commands for advance, back, screen forward, screen back, and locating. Finally, the student is introduced to more advanced procedures, such as using the new page and cut page commands. Also, several common word processing features are described, such as centering, spacing, and numbering pages.

The components of the module described above enable the student to gain a fundamental working knowledge of Braille-Edit and to provide him/her with the benefit of word processing capabilities. It is anticipated that this module can be extended to include other options available in the system as the need arises or that the student can refer to the documentation accompanying Braille-Edit.

The work described here is a first step toward development of instructional modules to teach word processing through Braille-Edit. Parallel modules can be developed for other input/output options using the existing module as a model. Braille-Edit is continually being revised, so changes will be necessary to reflect these revisions when necessary. Comments and suggestions from the field reviewer were very positive and continued work is being planned even after the grant period ends. Future work will occur as part of an equipment grant from the Apple Education Foundation. In this project we will explore development of word processing and writing skills of visually impaired students at the Tennessee School for the Blind in cooperation with Peabody College/Vanderbilt University.

TABLES 1-6

Table 1

DESCRIPTION OF PARTICIPATING STUDENTS

(N=34)

Student		Sex	Grade	Date of Birth	Age	Yrs. in VI Program	Acuity rt eye/lt eye	Date of Examination	Etiology	Onset
TSB	1	M	11	4/04/64	18	7	20/300	--	severe myopia, nystagmus	Birth
	2	F	11	10/16/61	21	9	LP	2/18/82	optic Atrophy	Unknown
	3	M	10	9/28/66	16	9	8/200;8/300	11/81	optic Atrophy, nystagmus	--
	4	F	10	5/27/67	15	10	2/100; HM	12/81	bilateral congenital microphthalmus cataracts	Birth
	5	M	11	7/26/65	17	10	20/200+;20/80	12/81	cataracts, bilateral aphakia	Birth
	6	M	11	9/15/64	18	1	20/200;20/300	1980	detached retina	1979
	7	M	11	5/17/63	19	14	20/200;20/400	1978	high myopia, pendular nystagmus	--
	8	M	6	7/20/67	15	10	nil	1972	congenital anophthalmus	Birth
Neb.	BM	M	8	8/15/67	15	2	nil	3/83	(?) congenital-lost completely 2 yrs ago	Birth
	DS	M	7	7/19/70	12	5	20/200 $<5^{0}$ field	2/21/83	Stargards macular degeneration	CA 5
	GK	M	6	9/10/70	18	7	nil	3/10/81	retrolental-fibroplasia	Birth
	TE	M	11	3/09/65	18	12	LP	--	embryophathy retonopathy	Birth
	TN	M	5	3/10/70	13	6	LP	3/19/81	optic atrophy	Birth
KY-	M1100	M	11	12/08/65	17	--	CF4'; CF1'	5/25/83	Crouzons disease	Birth
	J1200	M	12	3/25/65	18	--	HM1'; HM1'	5/05/82	retinitis Pigmentosa	Birth
	K1200	F	12	5/05/64	18	12	NLP; 20/400	9/28/82	congenital cataracts	Birth
	B1200	F	12	5/12/64	18	13	HM2'; HM4'	12/09/81	congenital amaurosis of retinal origin	Birth
	H1200	M	12	5/08/64	18	--	CF5'; CF2'	3/02/83	retinitis pigmentosa, lateral nystagmus	Birth
	M1200	F	12	5/29/63	20	12	NLP	9/15/82	retrolental fibroplasia	Birth

LP - light perception; NLP - no light perception; HM - hand movement; CF - counts fingers
-- information not provided

DESCRIPTION OF PARTICIPATING STUDENTS (continued)

Student	Sex	Grade	Date of Birth	Age	Yrs. in VI Program	Acuity rt eye/lt eye	Date	Etiology	Onset
NY-JM	M	9	1/17/66	17	8	LP	--	glaumoca	Birth
TS	M	11	11/04/62	18	11	Totally blind	--	retinoblastoma	Birth
JM	M	ungraded	1/12/65	18	1½	20/200;20/200	--	tumor	8
BA	M	9	6/15/66	16	2	20/200;20/200	9/83	--	Birth
CB	M	12	1/05/63	20	6	2/400; NLP	--	glaucoma	Birth
JM	M	6	3/10/64	14	6	20/200; NLP	--	glaucoma	Birth
CR	M	7	1/17/69	14	5	20/200;10/200	--	optic atrophy	Birth
? TR	M	-	1/17/69	14	½	20/200;10/400	9/83	--	Birth
DeKalb, Georgia									
Todd	M	8	3/16/68	15	6	CF;20/80	8/11/82	coloboma of retina	Birth
Aimee	F	10	10/10/66	16	11	NLP; LP	9/03/81	microphthalmos & cataracts	Birth
Heather	F	12	9/13/64	18	--	NLP	2/09/81	retrolental fibroplasia secondary glaucoma	Birth
Victor	M	9	5/24/68	14	13	LP	3/14/82	optic atrophy	Birth
Lane	M	8	7/09/68	14	8	20/100;20/100	8/20/80	retinitis pigmentosa	Birth
Mark	M	11	9/20/64	18	8	CF;20/60	8/10/81	tumor	--
Danny	M	8	9/14/68	14	9	20/200	9/28/81	--	--

LP - light perception; NLP - no light perception; CF - counts fingers; -- information not provided

Table 2

SUMMARY OF STUDENT'S INITIAL SKILLS

(N=34)

Part II

		None	Some	Lots
1.	Typing Skills	0	12	23
2.	Braille	16	3	16
3.	Optacon	20	6	9
4.	VersaBraille	25	5	5
5.	Micro. Exp.	16	13	6

Table 3

TEACHER BACKGROUND QUESTIONNAIRE

Part I		YES	NO	NR
1.	Have you had microcomputer training/instruction?	3	5	1
2.	Have you ever operated/used a microcomputer?	6	3	0
3.	Are you interested in microcomputers for personal use?	8	1	0
4.	Are you interested in microcomputers for educational (classroom) use?	9	0	0
5.	Are you familiar with the VersaBraille?	6	3	0
6.	Are you familiar with the Optacon?	8	1	0
7.	Do you think microcomputers, the VersaBraille, and the Optacon are useful in the field of vision?	9	0	0

Table 4

PRETEST-POSTTEST ANALYSIS OF TEACHER RESPONSES TO MODULES QUESTIONNAIRES

		(Scale 1 to 5)	
		PRE	POST
1.	Work with micros enjoyable.	4.7	5.0
2.	Micros can be useful in education.	4.9	5.0
3.	Work with micros is interesting.	4.8	5.0
4.	Micros can aid students with scholastic achievement.	4.7	4.9
5.	Micros offer students increased pre/voc options.	4.8	5.0
6.	V.I. students should learn to use micros.	5.0	5.0
	$\overline{x}$ =	4.82	4.98
	sd =	.12	.04
	n =	9	10

$\underline{t}$ = 1.832   df = 17 $\underline{p}$ .05

		PRE	POST
		Y, N, YR	Y, N, NR
7.	Grade level checklist		
8.	Will you continue to use micros with V.I. students?	8, 0, 1	8, 1, 1
9.	Would you recommend micros to other V.I. teachers?	9, 0, 0	9, 1, 0

Table 5

PROPORTION OF STUDENTS COMPLETING THE MODULES

Module Test	Mean # of trials	# of students	% of students
Module I	1.28	29	100
Module II Objective 1	1.44	25	86
Module II Objective 2	1.13	16	55
Module II Objective 3	1.00	1	3
Module II Objective 4	1.00	11	38
Module III Objective 1	1.00	3	10
Module III Objective 2	1.50	2	7
Module III Objective 3	1.00	1	3

Table 6

PRETEST-POSTTEST ANALYSIS OF STUDENT RESPONSES TO MODULES QUESTIONNAIRES

(Scale 1 to 5)

		PRE	POST
1.	Work with micros is enjoyable.	4.7	4.8
2.	Micros can be useful in education.	4.6	4.8
3.	Work with micros is interesting.	4.8	4.7
4.	Micros can aid students with scholastic achievement.	4.4	4.6
5.	Micros offer students increased pre/voc options.	4.4	4.7
6.	V.I. Students should learn to use micros.	4.8	4.7
	$\bar{x}$ =	4.62	4.72
	sd =	.18	.08
	n =	35	34

$t = .7144$ $df = 67$ $.05 < p < .25$

		PRE	POST
		Y, N, NR	Y, N, NR
7.	Grade level checklist		
8.	Will you continue to use micros?	35, 0, 0	33, 0, 1
9.	Would you recommend the use of micros to other students?	34, 0, 1	33, 0, 1

OBJECTIVE 3

Objective 3: To develop and evaluate instructional packages for these multimedia microcomputer systems for the inservice and preservice training of special education and other personnel who work with visually impaired youth.

There is no doubt that computers pervade our society, even to the extent that they became "machine of the year" in 1983 (Time Magazine, 1983). As the Time article states, " . . . the enduring American love affairs with the automobile and the television set are now being transformed into a giddy passion for the personal computer (p. 14)." An acknowledgement of this trend by the field of education is inescapable, since as Papert (1980) stated, "educational innovators must be aware that in order to be successful they must be sensitive to what is happening in the surrounding culture and use dynamic cultural trends as a medium to carry their educational interventions (p. 181)."

If it is not immediately evident that microcomputers can and will have a profound influence on education, then consider the following statement by Papert (1980): "I believe the computer presence will enable us to so modify the learning environment outside the classrooms that much if not all the knowledge schools presently try to teach with such pain and expense and such limited success will be learned, as children learn to talk, painlessly, successfully, and without organized instruction (p. 9)."

Without suggesting that such a radical change is imminent, it is clear that many believe that the quality of education can be significantly improved through the use of computers. If such claims are even partially realized, then it will be essential that teachers of the visually impaired be prepared to implement the use of computers so that visually impaired students can obtain similar educational benefits.

For teachers of visually impaired students to be fully prepared to implement the use of microcomputers, they must first understand the many ways that have been suggested for their use in regular education. Once an understanding of how microcomputers can be used is gained, then these teachers must understand the means and special devices which are required for visually impaired students to access the microcomputers. With these two broad objectives in mind, a one-day teacher inservice workshop introducing the use of microcomputers in education and access devices for visually impaired microcomputer users was developed. (See Appendix F.)

Organization

Learning to use computers has at least as much in common with learning to drive a car as it does with learning an academic subject. Learning to use a computer is a skill which requires first-hand experience to become proficient. Without "hands-on" experience, instructions on how to operate the computer can be quickly and easily forgotten. First hand experience makes the instruction meaningful and, thus, facilitates learning. The use of access equipment is much the same. Much can be said about access devices, but without

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hands-on experience, such explanations lack meaning. Therefore, the teacher inservice workshop introducing microcomputers and access equipment was designed to include both an informative lecture about the equipment as well as time for hands-on experience. This was accomplished by scheduling the morning for formal presentations, and providing stations with demonstrations of the access equipment in the afternoon, which the participants could rotate through in groups and experience the devices first hand (see schedule in Appendix F).

The workshop was targeted to benefit teachers and administrators who work with visually impaired students, and those who had little or no experience with microcomputers or access devices. To meet the needs of this audience, it was important to give the background and content for discussing access equipment, and not simply the technical information alone. Provision was made for participants with need for more advanced information to receive in-depth assistance through the afternoon hands-on activities.

Content

To accomplish the main objective of introducing both the use of microcomputers in education and the access devices necessary to enable their use by visually impaired students, four major topic areas were identified. Each of these topics was addressed through a separate concept outline and associated workshop presentation (see Appendix F for example workshop package). These included: (a) the role of microcomputers in society in general, (b) the fundamental concepts of computer technology, (c) the role of microcomputers in education, and finally, (d) the access devices which make the technology accessible to visually impaired youth. Each area was considered important for a complete introductory understanding of the topic, and the sequence was designed to provide the groundwork for addressing the topic of microcomputer access by visually impaired students. In this sense, the workshop was organized to answer the question "Why be concerned with accessing microcomputers?" first, then to address the question "How can widely diverse visually impaired students gain access to microcomputers?"

The first three topic areas provided the background and framework for the discussion of access devices. First, a broad prospective on the use of computers throughout society was given. Following this, an introduction to the technical language and major concepts for discussion of computers was provided so that later discussions of access equipment could be explained in relation to technical aspects of the microcomputers themselves. Finally, the ideas of major writers in the field about how microcomputers might prove useful in education were summarized and discussed. In this way, the rationale for providing access to microcomputers for visually impaired students was provided to participants.

The final topic area, microcomputer access devices, was divided into three modes of access: Tactile access through Cassette Braille devices and the Optacon; auditory access through voice output devices; and visual access through methods for producing large print output. The cassette braille devices discussed included domestically available models, such as the VersaBraille and Microbrailler, as well as more recent innovations, such as the anticipated American Foundation for the Blind Full-Page Braille and Tactile Graphic Display, DataBraille, and the BD 80 from Germany. Voice output was divided into two categories: Digitized speech and Synthetic speech. Mountain Hardware's Supertalker was the principal digitized speech demonstrator and the Echo II, Votrax Type-N-Talk, and Maryland Computer's Total Talk were the synthetic speech devices included in the workshop discussion, demonstration and hands-on opportunities. The OPTACON provided a unique means of tactile access to microcomputers. For users trained in the operation of the OPTACON, a special CRT lens attachment enables the OPTACON to read most microcomputer visual displays, thus allowing direct access to visually displayed information; therefore, the discussion of the OPTACON was limited to the CRT lens and its attributes and utility. Closed circuit television systems which enlarge the visual output, double-wide characters generated by the microcomputers themselves, and commercially available software to modify programs to display large print were all discussed and demonstrated under the topic of large print generation. The advantages and limitations of each means of access concluded the discussion of each device and questions and discussion from the audience were always encouraged.

Workshop Evaluation

Evaluations were conducted to determine the value and effects of the workshop on teachers and administrators in the education of visually handicapped students. Formative evaluation was used to develop and to in a formative manner to improve the workshop content and presentation. New information was incorporated in the workshop as it was generated in the microcomputer laboratory and/or became available from other sources. While the workshop materials underwent alteration of a substantive nature due to new information, the method and sequence of presentation was minimally altered and the compiled results provides a summative evaluation of the final workshop product.

Method

Sites

Workshop materials developed by the project staff were evaluated through four on-site trials, each at a different site. The first trial was March 22, 1982 at the Kentucky School for the Blind. At this site, 15 teachers and administrators attended the workshop and completed evaluations. The second trial was given June 16, 1982 at the Georgia Academy for the Blind. At this site, 24 teachers and administrators attended the workshop presentation and completed evaluations. The next trial was given on September 20, 1982 for the itinerant vision staff of the

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DeKalb County, Georgia Public Schools. At this site, 15 teachers and administrators attended the workshop and completed evaluation forms. The final trial of the workshop materials was given July 6, 1983 for the staff of the Nebraska School for the Visually Impaired and other interested vision specialists from neighboring states. At this site, 26 teachers and administrators attended the workshop and completed evaluation forms. The evaluation summary is based on the compiled data for all 80 participants.

Procedure

The workshop materials and presentations were evaluated in two broad ways: through measurement of their effects on participants and through survey of participants' reactions to the materials and presentations.

The effects of the workshop on participants' attitudes, opinions, and knowledge, were evaluated using a pretest-posttest design. Attitudes were measured through the use of a semantic differential scale (Kerlinger, 1973) surveying their attitudes toward personal computers. Participants' opinions about computers were measured using a four item Likert-type scale, and participants knowledge about access devices was measured using a five item multiple choice test. All items were administered twice: first, at the beginning of the workshop and again following the 3-1/2 hours of formal workshop presentations.

Participants' overall reactions to the workshop content and presentation were also surveyed. Their general opinions of the usefulness of the workshop were measured using a 4-item

Likert-type scale. Participants' assessments of the quality of the content, presentation, and presenters of the workshop were measured on a 5-point scale by content heading (eight areas covered). In addition, participants' prior computer experiences, comments, their opinion of the strengths and weaknesses of the workshop, and their self-report of whether they would continue to use computers were measured through format-free questions at the end of the evaluation form. The evaluation form for participants' overall reactions was administered only once, following afternoon hands-on activities.

Finally, a meta-evaluation of the pretest-posttest evaluation instrument was conducted. It simply consisted of item analyses of the multiple choice items of the knowledge test as administered at each site.

Results

The results in Table 1 show the mean increases from pretest to posttest across all participants for both the Semantic Differential scale and the pretest-posttest knowledge items. The last column of Table 1 shows the average of these figures across the four presentations of the workshop: the Semantic Differential was not included in the Kentucky workshop evaluation and is therefore excluded. The greatest gain on the Semantic Differential scale was obtained at the DeKalb presentation (.92 on a 7 point scale), but increases were gained at all sites. The average increase was more than half a point (.60) on a 7 point scale. On the knowledge test, the highest gains were again obtained at the DeKalb presentation (1.27 on a 5 point scale). The average increase for all sites on the knowledge test was more than 3/4 of a point (.76) on a 5 point scale: increases were again in evidence at all sites. With increases in all areas it is possible to conclude that there was a consistent overall positive impact of the workshop presentations on attitudes about computers and on knowledge of access devices and equipment.

Table 2 contains a summary of the results of the evaluation of participants' reactions. The mean scores across all participants for the content, presenter, and presentation in each access technology area covered by the workshop are displayed by site, and the last column contains the average across sites. While presenter and presentation composite scores are unintepretable (due to different presenters at different sites), the content scores meaningfully represent participants' evaluation of the workshop materials. The highest evaluation for content was obtained for the voice synthesis mode of access component of the workshop (4.33), while the lowest was for the cassette braille recorders (CBRs) or tactile mode of access component (4.07). All content evaluation scores were above 4.00 on a 5 point scale, suggesting a highly favorable evaluation by participants from all four sites.

Copies of the evaluation summaries from each individual site, which were used by grant staff to modify the workshop materials following each presentation, are included in Appendix B. The initial evaluation form for the first presentation at

Kentucky was sufficiently different to require separate inclusion (following the Kentucky site evaluation) and the final evaluation form is included at the end of Appendix B. The results of these individual evaluations support the conclusion that reactions to the workshop were highly favorable at all sites.

Discussion

The results of the workshop evaluation strongly support the conclusions that the workshop materials provided a stimulating, informative, and beneficial inservice training experience for participating teachers of visually impaired students. Participants' attitudes towards computers became more positive, they reported benefiting from the experience and rated the content very high, and their knowledge of access equipment was increased. Taken together, these results are solid evidence for suggesting that other teachers will benefit from exposure to presentations of these workshop materials. The only mitigating factors would be the quality of the presenter and the circumstances of the presentation. These factors, unrelated to the content of the workshop, must be considered key to the successful presentation of the materials. It is felt that the presenters and circumstances used for the sites were of high quality. Presenters were very knowledgeable in the area of microcomputers and access equipment. Also, small room settings were available for hands-on experiences, lecture settings were available for morning presentations, and all equipment was reliable and functional. These variables should be taken into account when the highly successful nature of these materials is considered.

Overall, when a presenter who is familiar with the equipment is provided, and logistics of the presentation are considered, these materials can provide a solid introduction to the use of computers in education, and specifically their use for the education of visually impaired students.

TABLES 1 & 2

Table 1

Summary of Pretest-Posttest

WORKSHOP EVALUATIONS SUMMARY

	KY	GAB	DeKalb	NE	Average Increase
Semantic Differential Evaluative Factor	-	.44	.92	.44	.60 of 7 pts.
Improvement from Pretest to Posttest	.47	.70	1.27	.61	.76 of 5 ques.

Table 2

Summary of Participants Reactions Evaluation

LIKERT SCALE from 1 to 5 (5 = High)

		KY	GAB	DeKalb	NE	Average
CBRs	content	3.75	4.42	4.33	3.76	4.07
	presenter	3.81	4.57	4.27	3.53	4.05
	presentation	4.00	4.57	4.20	3.65	4.11
Voice	content	4.82	3.86	4.20	4.18	4.33
	presenter	4.81	4.57	4.20	4.44	4.51
	presentation	4.25	4.43	4.40	4.41	4.37
Optacon	content	4.07	4.57	4.47	3.39	4.13
	presenter	4.13	4.57	4.33	4.13	4.29
	presentation	4.13	4.43	4.33	3.93	4.21
Lg. Print	content	4.06	4.00	4.40	3.93	4.23
	presenter	3.94	4.29	4.40	3.87	4.13
	presentation	4.06	4.43	4.40	3.53	4.11
Overall	content	4.00	4.29	4.30	3.97	4.14
	presenter	4.01	4.50	4.32	4.18	4.25
	presentation	3.95	4.50	4.33	4.13	4.23

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OBJECTIVE 4

Objective 4: To evaluate selected, adapted, or specially developed computer assisted instructional (CAI) programs for curricular, prevocational, and avocational purposes.

Comprehensive and effective evaluation of educational software for microcomputers is an enormous undertaking. Even when the pool of potential programs is restricted to those broadly referred to as Computer Assisted Instruction (CAI), the ever-expanding number of programs necessitates a large-scale organized effort. Many evaluations of specific packages, some multi-million dollar efforts, have been conducted. For example, the PLATO and TICCIT packages were both part of a formal 5-year evaluation conducted by the Educational Testing Service (Alderman, Appel, and Murphy, 1978). CAI has also been evaluated on a more limited scale through its implementation in specific areas. For example, the Computer Curriculum Corporation's (CCC) programs in reading, arithmetic, and language arts were evaluated in use by schools in 24 states (Macken and Suppes, 1976; Poulson and Macken, 1978). Yet, these efforts do not begin to address the wide variety of programs being marketed as CAI by many different software producers. As program production continues to expand monthly, the evaluation problems continue to be compounded.

The National Institute of Education (NIE) has supported some needed large-scale efforts to evaluate commercially available educational software. Through NIE's support of efforts at the Northwest Regional Educational Laboratory, a clearinghouse for software evaluations was developed in 1979. The Microcomputer Software and Information for Teachers (MicroSIFT) project has been conducting sound formal evaluations of educational software since that time.

The use of special devices which make microcomputers accessible to visually impaired students adds additional constraints which must be considered when evaluating CAI or other educational software for use in classrooms serving visually impaired students. These constraints lead to the need for additional evaluation criteria, which can be identified through evaluating a limited number of programs which have been selected to be representative of a variety of CAI programs.

Due to the scope of undertaking of comprehensive evaluation effort, the current project, instead, supported the work of the MicroSIFT project. Even re-evaluating educational programs (having already been determined by MicroSIFT to be of sound educational quality) taking into consideration the additional criteria required by the use of access equipment, was determined to be beyond the scope and financial capabilities of the current project. However, a means was developed to incorporate the knowledge gained by project efforts into the evaluation of educational software for use by visually impaired students.

Since broader educational software evaluation efforts were beyond the scope of this project, project efforts toward the completion of Objective 4 were directed toward the development of a complete and valid set of evaluation criteria which considered the additional constraints placed on software by the use of special equipment for visually impaired microcomputer users. They were developed to complement, but not to supplement, evaluation criteria directed at determining the educational value of programs.

As a result of other project efforts (primarily those described under Objective 1) and a formative evaluation (described in the next section) twelve criteria for software evaluation were identified. The complete list of these criteria appears on the Statement of Policy and Criteria for Software Evaluation form (see Appendix E). They were intended for use by teachers of visually impaired youth who have little or no computer experience. They represent general criteria which cover issues for students throughout the wide range of visual impairments. Not all criteria would be appropriate for determining usefulness for any one particular student; and, thus, no one criterion is meant to be sufficient for the acceptance or rejection of a particular piece of educational software. Rather, each criterion is intended for consideration of its appropriateness when a specific combination of student and access equipment has been determined.

Evaluation for Educational Value

A number of forms and procedures for the evaluation of the educational value of CAI and other educational software were identified by project staff. Three of these forms; those from CONDUIT (located at the University of Iowa), Teaching Exceptional Children (Hannaford & Sloane, 1981), and MCE, Inc. are included in the Appendix in addition to the MicroSIFT evaluation forms.

The MicroSIFT evaluation process was adopted and endorsed by this project. It was felt by project staff that the MicroSIFT evaluation procedures produced a comprehensive high-quality assessment of the educational value of software which they studied. Their four-stage evaluation process can be summarized as follows:

1. SIFTING. An initial judgment is made whether a program or package is suitable for microcomputer use in grades K-12 and is ready for evaluation. Certain fundamental criteria must be met: does it have instructional value as opposed to strictly recreational), can it be run on a microcomputer with little or no adaptation, etc.

2. DESCRIPTION. Factual information about the program and materials is reviewed; i.e., instructional purpose, technique, package form, documentation availability, and so forth.

3. EVALUATION. Professional teachers with experience in the program's subject area and stated grade level review the material, test the program, and make judgments concerning its value as an instructional package.

4. IN-DEPTH EVALUATION. When a package successfully passes the first three stages and is rated highly enough to warrant further evaluation, instructional effectiveness is assessed through pretesting and posttesting, student observation, or other means. An expert in the package's field of study supervises the in-depth evaluation and makes a recommendation and/or judgment to MicroSIFT regarding the usefulness of the

program. An Evaluator's Guide contains standardized forms which are used to record professional judgments (a portion of which appear in the Appendix). (Marler, 1980, p. 3)

The reviews conducted by the MicroSIFT project are being made available in a number of ways. They are currently available through ERIC, and occasionally are printed by the Computing Teacher Magazine. They are also available through an electronic data base, RICE (Resources in Computer Education).

Evaluation of Accessibility by Visually Impaired Students

A modified Delphi technique was used simultaneously to develop and to validate criteria for the evaluation of educational software for use by visually impaired youth. An initial set of eleven criteria were written based on the experience of project staff, both in the research lab and in earlier on-site field trials. Feedback from 18 nationally known experts in the area of the use of microcomputers either by visually impaired persons or their sighted peers was solicited. The experts who provided feedback through the modified Delphi technique included: Larry Scadden, Guy Carbinneau, David Holladay, Richard Evensen, James Bliss, Tim Cranmer, Emerson Foulke, Ted Hasselbring, Fred Sinclair, Phyllis Brunkin, Frank Irzyk, Harvey Lauer, Doug Archer, W. J. Morrissey, Patrick Schwab, Janet Simon, Dean North, and Bill Davis.

After three rounds of evaluation where additions, deletions, modifications, and comments were sought from all participants, a final set of twelve (12) criteria received consensus support.

The final set of criteria comprised two new criteria not in the original draft, the deletion of one criterion, and significant modification of many of the other original criteria. The final set of criteria are included in Appendix E.

Discussion

The comprehensive and effective evaluation of CAI and other educational software requires a large-scale effort in real-life educational settings on an ongoing basis. The evaluation and endorsement or rejection of specific CAI packages involved complexities beyond the capabilities, scope, and authority of a federally funded project of this type. Thus, we decided instead to concentrate efforts on the development of evaluation standards, criteria, and procedures which took into account the constraints placed on the use of software when utilized in connection with the special access equipment required by visually impaired students. Through the incorporation of the input from 18 other experts in the area of microcomputer access augmenting project staff, a comprehensive and consensually validated set of 12 criteria were identified. These criteria are improving and will continue to improve the ability of teachers of visually impaired students knowledgeably to evaluate educational software for selection and use in their classrooms. The criteria developed by this Project are designed to be applied in addition to or as a supplement and complement to a sound evaluation of the educational value of selected software. The evaluation procedures and format of the MicroSIFT project were adopted by the project. The combination of the supplemental criteria with a sound educational evaluation provides a powerful tool for teachers interested in effective use of microcomputers with their visually impaired students.

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OBJECTIVE 5

Objective 5: To disseminate the results and products of the research project through usual dissemination channels.

Dissemination of information accruing from findings of the project was a significant objective. Not only were specific dissemination efforts made in response to Objective 5, but the efforts involving other objectives were also designed to maximize continuous dissemination of information to the broadest audience. For example, when workshops were presented in the attainment of Objective 3 a brief segment on the nature and activities of the project, its objectives and a current progress report were always included. The development and presentation of the workshops themselves served to disseminate information regarding access technology to residential schools and day school programs. In this way the requirements of Objective 5 were being met as the activities of Objective 3 were pursued.

The participants in the on-site field test of student modules of Objective 2 also participated in disseminating information regarding access technology and project findings. Frequent interactions between participating teachers and project staff resulted in the creation of local area "experts," with experience in the use of microcomputers and access devices, and personnel who were familiar with the findings and products of this project.

Microcomputer Lab Demonstrations

In addition to dissemination activities associated with the attainment of the other objectives of this project, a variety of specific dissemination efforts were designed and carried out. The microcomputer lab served as a focal point for brief seminars and group and individual demonstrations of project equipment, activities and findings. Demonstrations of this sort were given to widely diverse audiences. The first type of audience was individuals who were visually impaired who wished to learn more about microcomputers and access devices. Such individuals frequently became aware of the project by word of mouth, by networking among interested people, and through other more formal dissemination efforts. Also, occasionally interested individuals were referred to the project by various access equipment suppliers.

Dissemination efforts of the microcomputer lab were also directed toward students, faculty and others at Peabody College and Vanderbilt University. Presentations and demonstrations were given to Special Education classes for pre-service teachers of visually impaired persons as a component of their training. Visually impaired students at the university served as subjects for pilot study and were encouraged to become familiar with access devices at the lab. Technical assistance was given to visually impaired students taking computer-related courses in their own degree programs at the university. Demonstrations were also given in electrical engineering courses and to other groups of interested students. Guests of the university and national and international consultants to the university frequently requested demonstrations, and the Board of Trustees of the university requested and received a presentation of project activities and findings at its fall meeting. In addition, the microcomputer lab served as a source of technical assistance, when possible, to other university staff involved in complex interfacing with serial, RS-232-C compatible, peripheral equipment.

Dissemination efforts were also directed to a variety of community groups. Teachers in local day schools and the Tennessee state residential school serving visually impaired students received demonstrations and consultation upon request. Local and state rehabilitation workers requested and received demonstrations and technical information on a continuing basis. Organizations such as the American Printing House for the Blind in Louisville, KY, the local association of Data Processing Managers, and the local Apple Users Group received demonstrations through the course of this project.

Finally, corporations received information, technical assistance, and demonstrations of project findings. For example, a brief demonstration was given to local businessmen as part of attempts to increase the employment of handicapped workers. SRA and IBM officials also came to the microcomputer lab for a demonstration of findings. The demonstration to IBM officials resulted in the long-term loan of an IBM-PC microcomputer to provide for a project-related study of IBM personal microcomputer access for visually impaired individuals comparable to the work done with the Apple and TRS-80.

Dissemination Workshops Held:
(See Workshop Outline and Modules for content)

Tennessee School for the Blind, Donelson, TN

Metropolitan Nashville Teachers of Visually Impaired, Nashville, TN

Kentucky School for the Blind, Louisville, KY

Peabody College, Vanderbilt University, Pre-Service Teachers, Nashville, TN

DeKalb County Georgia Public Schools, Atlanta, GA

American Printing House for the Blind, Annual Meeting. More than 200 participants from most of the 50 states and Territories. Louisville, KY

Perkins School and Massachusetts Area Teachers, Watertown, MA

Midwest Regional Conference, Nebraska School for the Blind, Nebraska City, NB

Tennessee School for the Blind and Statewide Conference Tennessee Local Day School Teachers, Donelson, TN

Iowa State Department of Education, Statewide Conference, Cedar Rapids, IA

Conference Presentations Made:

Dallas Independent School District, Media Fair, Dallas, TX - 250 from throughout state

CEC National Conference on Technology, Hartford, CT

Kansas State Department of Education, Statewide Conference

American Printing House for the Blind 1983 Annual Meeting

Symposium, Student-Use Media for Severely Handicapped Learners: Microcomputers and You, Nashville, TN

Journal Articles:

The following four articles are in-press for publication in a special issue of the journal Education of the Visually Handicapped for Spring publication. S. C. Ashcroft is the special issue editor.

Research on Multimedia Access to Microcomputers for Visually Impaired Students, S. C. Ashcroft

Evaluating Microcomputer Access Technology for Use by Visually Impaired Students, by Sandra Ruconich

A Formative Evaluation of an Instructional Program Designed to Teach Visually Impaired Students to Use Microcomputers, by LaRhea Sanford

Independence for the Visually Handicapped Through Technology, by Phyllis Brunken

The following article is in-press to appear in a special issue of Exceptional Education Quarterly:

Making Microcomputers Accessible to Blind Persons, by Sandra Ruconich, S. C. Ashcroft, and Michael Young

The following paper is to appear in Proceedings of the National Conference on the Use of Microcomputers in Special Education, Hartford, CT, March, 1983:

Research on Multimedia Access to Microcomputers for Visually Impaired Youth

The following paper has been submitted to the Journal of Visual Impairment and Blindness:

Issues in the Dissemination of Educational Microcomputer Technology

The Instructional Modules are available from the Learning Technology Center of Peabody/Vanderbilt:

Instructional Modules for Beginning Microcomputer and Access Technology Skills for Visually Impaired Students. Research on Multimedia Access to Microcomputers for Visually Impaired Youth, Department of Special Education, Box 328, George Peabody College for Teachers, Vanderbilt University, Nashville, TN 37203

Additional Articles include:

1. The Journal of Special Education Technology (Fall, 1983)

2. Peabody Reflector, Spring, 1983, p. 28

3. Vanderbilt Register, July 8, 1983, p. 2

4. Nashville TENNESSEAN, March 14, 1983, p. B1

5. Closing the Gap, June-July, 1983, p. 3

Dissertations:

Two dissertations and one Specialist in Education degree project have been done in association with the project. They are:

Ruconich, S. The Effectiveness of Audio-Tutorial and Braille Instruction in Teaching Braille Reading Youth to Operate the Cranmer Modified Perkins Brailler as a Computer Terminal. December 1983 Ed.D. dissertation, George Peabody College for Teachers of Vanderbilt University.

Sanford, L. Effects of Age and Intelligence on Use of Microcomputers by Visually Impaired Students. Ed.D. dissertation in process, Peabody College/Vanderbilt.

Schenk, W. A Computer Literacy Course of Study for the Tennessee School for the Blind. Ed.S. degree project in process, Peabody College/Vanderbilt.

Nation-Wide Survey and Progress Report

In addition to articles concerning the project, a nation-wide survey was conducted to determine the use of microcomputers and access devices in programs serving visually impaired students. A project description and progress report was also disseminated at that time to the 158 organizations surveyed. The results of this survey and a comparison of the results with earlier (1980 and 1981) findings are reported in the next section. As a result of these dissemination efforts, project staff have received numerous requests for teacher in-service workshops, copies of the student modules, and technical information regarding access devices and evaluations of equipment. These requests are being met to the extent possible as efforts towards project objectives are continued. Yet, they highlight a national need for continued and more diverse efforts to disseminate information regarding the access of microcomputers by visually impaired individuals.

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Survey of Microcomputer Usage

Three surveys were conducted to determine the number of microcomputers in use by 158 organizations identified as serving visually impaired persons. These surveys, conducted in 1980, 1981, and 1983 yielded an increasing number of respondents (35, 44, and 91, respectively). This tended to obscure trends in the field, since organizations responding only to the 1983 survey were heavily weighted with organizations whose population was multihandicapped and who had only recently begun to consider themselves reasonable candidates for the application of microcomputers as a part of their services. The increased interest in microcomputers by organizations serving multihandicapped students is itself an important trend; however, any interpretation of these data must consider the weighted increase in such organizations responding to Survey III.

Results

The results of the 1980, 1981, and 1983 surveys are shown in Tables 1, 2, and 3 respectively. Response rates increased from 22%, to 28%, and finally to 58% for the most recent survey. It can be seen from these Tables that the use of microcomputers in direct service to students has increased dramatically from 2.9% in 1980 to 34% in 1983; thirty-one organizations rather than one reported having existing programs using microcomputers. In addition, the number of organizations expressing intentions to start programs also showed an increase, growing from 31% in 1980 to 71% in 1983. These increases in the data were demonstrated even with the addition of many organizations serving multihandicapped students among the 1983 respondents. This indicated a strong trend toward the increased use, and plans for use, of microcomputers throughout the community serving visually impaired persons.

While data on available equipment were not collected in 1980, comparisons can be made between the 1981 and 1983 findings in this regard. As a percent of total respondents, the availability of microcomputers increased from 30% to 34% in years 1981 to 1983, and the availability of VersaBrailles increased from 30% to 44%. While the total number of programs with OPTACONS available showed an increase from 37 to 65, and with Kurzweil Reading Machines available increased from 22 to 37, the increased responses by organizations serving multihandicapped individuals produced percentages of total responses which showed drops in these areas--84% (1981) to 71% (1983) for OPTACONS and 40% (1981) to 41% (1983) for Kurzweil Reading Machines. Further data were also collected on available access technology through the 1983 Survey III, and these findings are shown in Tables 3a and 3b. It can be seen from these tables that there are a wide variety of devices in use by programs serving visually impaired persons, most notably many devices (e.g., Echo II) which produce synthetic speech.

Summary

The results of these surveys indicated that the use of microcomputers by programs serving visually impaired persons is increasing at a moderate rate. An increasing variety of equipment is currently available, programs are under way, and many more are planned for the near future. The interest and use of microcomputers spans the type of programs surveyed, with residential schools, local day school programs, multihandicapped programs, and rehabilitation facilities all reporting the use of microcomputers in some application. With the growing interest in the use of microcomputers there is increasing availability of equipment, as well as information on existing programs' successes and pitfalls. Eighty-six percent of the respondents were interested in receiving information about the use of microcomputers by visually impaired persons. More than simply a request for materials, these findings suggest a need for continued and increased efforts to provide technical assistance, to publish formal evaluations of materials and methods as well as to share informally the experiences of integrating the use of microcomputers into services for visually impaired individuals.

RESOURCES FOR ACCESS TO MICROCOMPUTERS FOR VISUALLY IMPAIRED STUDENTS

Microcomputers for Blind Persons Box 328, Peabody College Vanderbilt University Nashville, TN 37203 (615) 322-8165	. Instructional modules designed to teach computer skills and access technology to visually impaired students
Raised Dot Computing 310 S. 7th Street Lewisburg, PA 17837 (717) 523-6739	. *Braille-Edit* Software (word processor for blind users, translates grade 1 to grade 2 braille and back) . *Super Cranmer Graphics Package* (enables Cranmer Modified Brailler to produce tactile version of pictures on the Apple monitor) . Dealer for Cranmer Modified Perkins Brailler . Monthly newsletter
Telesensory Systems, Inc. 455 North Bernardo Avenue Mountain View, CA 94043 (415) 960-0920	. Produces Versabraille (cassette braille machine) CRT lens for . Optacon Interface . Other computer products
Maryland Computer Services 2010 Rock Springs Road Forest Hill, MD 21050 (301) 879-3366	. Produces *Cranmer Modified Perkins Brailler*
Visualtek 1610 26th Street Santa Monica, CA 90404 (213) 829-3969	. Produces large print display processors . Other computer products
Computer Aids Corporation 4929 South Lafayette Street Fort Wayne, IN 46806 (219) 456-2148	. Produces "Documents" (a talking word processor for blind users)
Carroll Center for the Blind 770 Centre Street Newton, MA 02158	. Quarterly newsletter "Aids and Appliances Review"

Sensory Aids Foundation 399 Sherman Avenue, Suite 12 Palo Alto, CA 94306	. Monthly newsletter "Sensory Aids Technology Update"
Audio-Tech Laboratories 1158 Stewart Avenue Bethpage, NY 11714	. Bimonthly cassette newsletter, "Baud" (Blind Apple Users Discussion)
American Printing House for the Blind 1839 Frankfort Avenue Louisville, KY 40206 (502) 895-2408	
American Foundation for the Blind, Inc. 15 West 16th Street New York, NY 10011 (212) 620-2000	

TABLES 1, 2, 3

TABLE 1
SUMMARY OF SURVEY I (1980)

	Microcomputers in Academic Curriculum	Microcomputers in Vocational Curriculum	Future Academic Plans for Microcomputers	Future Vocational Plans for Microcomputers
Response Rate 35 of 158 (22%)	1	1	11	9
As % of 35 Total Responses	2.9%	2.9%	31.4%	25.7%

TABLE 2
RESULTS OF SURVEY II (1981)

	Current Programs	Future Plans	Interested in Workshop Material	Have Funding	Equipment						
					Digi	Versa	Any PBR	OPTACONS	KRM	Micros.	CCTVs
Response Rate 44 of 158 (28%)	10	25	31	25	1	8	8	37	22	13	29
As % of 44 Total Responses	23%	57%	70%	57%	2%	18%	18%	84%	50%	30%	66%

TABLE 3a
RESULTS OF SURVEY III (1983)

Response Rate 91 of 158 (58%)	Current Programs	Future Plans	Interested in Materials	Current Funding	Future Funding
# of Schools	31	65	78	38	46
As % of 91 Total Responses	34%	71%	86%	42%	51%

TABLE 3b

# of Schools	Micro-Computers	VersaBraille Model P2	MB2400 Microbrailler	Modified Perkins	Other CBR	OPTACONS	OPTACON CRT Lens	Echo II	Votrax TNT	MD. Computer Total Talk	Kurzweil	Other Synthetic Speech	Supertalker	Other Digitized
Current 83'-84'	40 6	28 5	6 2	4 3	3 1	65 2	16 3	16 3	9 3	9 0	37 1%	12 2%	1 0	4 0
As % of 91 Total Responses	44% 7%	31% 5%	7% 2%	4% 3%	3% 1%	71% 2%	18% 3%	18% 3%	10% 0	10% 0	41% 1%	13% 2%	1% 0	4% 0

Other Access Devices					
LED-120	LED-15	CCTV	Viewscan	FSST	Braille-Edit (software)
12	1	2	3	2	2
13%	1%	2%	3%	2%	2%

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APPENDIX A

PROCEDURES FOR INTERFACING THE IBM PC WITH THE VERSABRAILLE

PROCEDURES FOR INTERFACING THE IBM PC WITH THE VERSABRAILLE

EQUIPMENT

The following equipment will be needed in order to interface the IBM-PC and the VersaBraille:

1. An RS232 cable as described in Figure 2.
2. A disk containing the IBM-PC - VersaBraille interface program (PCBRAILL).
3. A disk containing DOS 1.1.
4. A VersaBraille model P2C or P2B.
5. An IBM-PC with two disk drives, 64K memory, keyboard, monitor, and an Asynchronous Communication Adapter with I/O addresses 3F8-3FF(hex).

PREPARATION OF THE IBM-PC

1. Turn on computer power switch located on back right side of computer.
2. Insert disk containing DOS 1.1 into drive A.
3. When DOS "A>date" prompt appears press ENTER key twice.
4. Insert the disk containing the interface program (PCBRAILL) into drive B.
5. With an "A>" prompt on the screen, type "B:" and press ENTER.
6. Upon receiving the "B>" prompt type "PCBRAILL", press ENTER. The computer will sound two beeps to indicate that the program is loaded.

7. Upon receiving the "B>" prompt type "A:" then ENTER to change active drive back to A.

8. With an "A>" prompt on the screen type "BASICA /C:0" (0 refers to the numeral 0) then press ENTER.

NOTES ON USE OF THE PCBRAILL PROGRAM

1. Some of the IBM-PC keys such as the function keys, insert, and delete cannot be used with the VersaBraille.

2. When EasyWriter or other word processing software is used the IBM-PC sends characters faster than the VersaBraille can receive them. This occurs for example in the EasyWriter program when the PAGE UP, PAGE DOWN, F1, or F4 keys are used.

3. Once loaded the PCBRAILL program cannot be removed from the IBM-PC's active memory except through the boot procedure (Alt)(Ctrl)(Del) or powering up again.

PREPARING THE VERSABRAILLE TO SERVE AS A TERMINAL

In order to use the VersaBraille as the IBM-PC's keyboard and display, perform the following steps:

1. Connect the specially prepared interface cable (see Figure 2) between the VersaBraille I/O cable and the Asynchronous Communication Adapter of the IBM-PC.

2. Turn on the power switch located at the back of the VersaBraille. When the power comes on the cassette door will open, and the display will read "ready".

3. Insert a formatted cassette tape in the door of the VersaBraille with the exposed tape side facing the user.

4. Close the cassette door by pressing on both front corners.

5. Display will read "select aud brl for". Press the braille select key located in the upper righthand corner of the device (see inside of VersaBraille cover for location of various keys.) When the braille select key is pressed, the machine will display the word "busy" and you will hear the tape turning.

6. The display will next read "name" when ready to proceed.

7. Using the braille keyboard, type in the new chapter name.

8. Set configuration control parameters by striking an (R) E (referred to as R chord E). This is done by striking a braille "r" (dots 1,2,3,5) and the space bar simultaneously followed by striking a braille "e" (dots 1,5) to access the parameter library. The ADVANCE BAR will allow the user to scroll through the library, and the WORD KEY will set the present parameter into memory. (NOTE: See VersaBraille manual for greater detail.) Use (R) S, this is done by striking a braille "r" (dots 1,2,3,5) and the space bar simultaneously followed by striking a braille "s" (dots 2,3,4), to return to the chapter in use. See Figure 1 for specific parameter settings.

9. Press the ADVANCE BAR. The display will read the cursor (dots 1,2,3,4,5,6) in the first position. This symbol will move as the text is entered, thus continually indicating the end of the text.

10. Put the device in remote mode by striking (R) R; this is done by striking a braille "r" (dots 1,2,3,5) and the space

bar simultaneously followed by striking a braille "r" (dots 1,2,3,5).

INSERT FIGURE 2 ABOUT HERE

INSERT FIGURE 3 ABOUT HERE

USER NOTES ON VERSABRAILLE

1. Dots 4,5,6 (the control key in microcomputer braille) followed by a braille "m" (dots 1,3,4) represent the carriage return signal for the Model P2B. When using the VersaBraille Model P2C or a modified P1, use dot 4 followed by a braille "m" for the return or enter.

2. The display on the VersaBraille contains a maximum of only 20 characters. To read material displayed on the CRT via the VersaBraille display, you must press the ADVANCE BAR at the end of each 20 characters read. When you reach the end of a CRT display, the VersaBraille will beep to signal that the end has been reached. You may back up 20 characters at a time by pressing the TEXT BACK key on the VersaBraille.

3. Since the VersaBraille can operate on its own battery supply, it must always be turned off individually in addition to turning off any other equipment.

4. If the panic eject key is pressed after the overlay has been loaded into the VersaBraille memory, the overlay will be

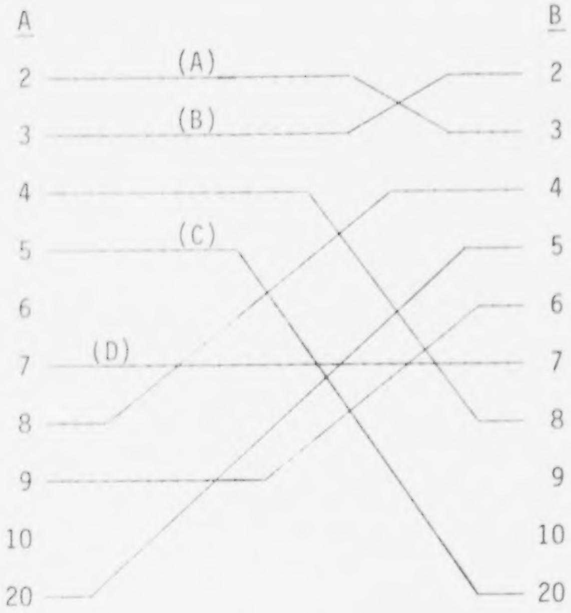
erased from memory.

5. Use Nemeth Code for writing numbers.

FIGURE 2

EQUIPMENT NAME: A VersaBraille

B IBM-PC



NOTES: To use VersaBraille model P2C with PCBRAILLE, only wires (A), (B), and (D) are required. A 25 pin FEMALE "D" connector is needed on both ends of the cable.

To use VersaBraille model P2 with PCBRAILLE, wires (A), (B), (C), and (D) are required. A 25 pin MALE "D" connector is needed on the VersaBraille end and a 25 pin FEMALE "D" connector is needed on the IBM-PC end.

FIGURE 3

CONFIGURATION CONTROL PARAMETERS FOR VERSABRAILLE

```
      Model P2C                               Model P2B

b 9600       et eot                  b 9600       et eot
d 7          dx f                    d 7          dx f
p e          hs dtr                  p e          hs dtr
s 1          ai n                    s 1          ai n
t c          co cr                   t c          ci y
ll 80        ak n                    ll 80        co cr
pl 0         dci y                   pl 0         ak n
ci sp        cts y                   cr 0         dsr n
cr 0         cd n                                 cd n
```

TECHNICAL DESCRIPTION OF PCBRAILL INTERFACE PROGRAM

The PCBRAILL program is an assembly language program that modifies the Personal Computer's interrupt routines for keyboard and display I/O (input/output). When the program is loaded, it remains in memory as an extension to the PC's disk operating system. The PCBRAILL program is written so that the routines perform the task of sending and receiving characters to and from the VersaBraille without affecting normal operation of the PC. Thus when PCBRAILL is loaded, the PC can communicate such as DOS, Basic, EasyWriter, etc.

The PCBRAILL program contains three routines: SET-UP, READ, and WRITE. The SET-UP routine initializes the Asynchronous Communications Adapter and redirects the interrupts vectors to point to the READ and WRITE routines. The READ routine receives characters from the VersaBraille through the Asynchronous Communication Adapter and places the ASCII characters in the PC's fifteen character keyboard buffer. THe READ routine is executed when the Asynchronous Communication Adapter receives a VersaBraille character and generates an interrupt. The code in the WRITE routine is executed when the PC performs a video I/O interrupt. This routine checks to see if the PC is sending a character to be displayed on the screen. If so, the WRITE routine sends the same character out the Asynchronous Communications Adapter to the VersaBraille. The READ and WRITE routines are described in more detail in the following sections. (Refer to the IBM Personal Computer Technical Reference Manual, page 3-3, for a listing of interrupt vectors.)

READ Routine

The READ routine is an interrupt routine and is executed whenever the Asynchronous Communication Adapter receives an ASCII character from the VersaBraille. To provide handshaking with the VersaBraille, the READ routine checks for XON and XOFF characters. The VersaBraille sends an XOFF character when it is too busy to receive characters from the PC. This can occur, for example, when the VersaBraille advances its cassette tape. The READ routine sets a flag when an XOFF is detected and clears the flag when the XON character is detected. The flag (labeled Transfer-Wait) is used by the WRITE routine to determine when it is safe to send characters to the VersaBraille.

The READ routine places each character received (other than XON or XOFF characters) into the PC's keyboard buffer. Once the READ routine has placed the character in the buffer, the PC processes the character just as if it had been typed on the Personal Computer's keyboard.

WRITE Routine

The WRITE routine, like the READ routine, is an interrupt driven routine. The WRITE routine is executed whenever the Personal Computer performs a video I/O interrupt (interrupt 10H). This is because the SET-UP routine changes the interrupt 10H vector to point to the start of WRITE code. The WRITE routine checks the AH register to determine the type of video I/O function -- cursor control, display scroll, character handling, or graphics -- that the PC is trying to perform. If the PC is attempting to write a character to the display, the AH register will contain a 9 or 10. Upon detecting this condition, the WRITE routine executes code to send the character to the VersaBraille through the Asynchronous Communications Adapter. Before the character is sent out, the Transfer-Wait flag is checked. If the flag is set, the WRITE routine waits for an XON character from the VersaBraille before sending the character.

The WRITE routine also determines when a carriage return and line feed should be sent out the Asynchronous Communications Adapter to the VersaBraille. The carriage return and line feed are used to indicate to the VersaBraille that a new line is being sent. The WRITE routine monitors the AH register to determine if the PC display is being scrolled (code 06) or the cursor is being moved to a new row (code 02).

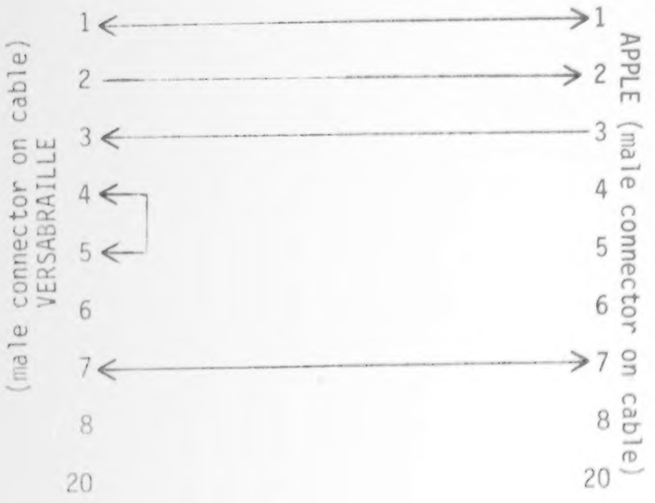
Because the regular video I/O functions in interrupt 10H have been replaced by the WRITE routine, the last function of WRITE is to perform the original interrupt video I/O function. Since the SET-Up routine placed the address of the BIOS video routine in interrupt vector number 60H, an INT 60H instruction performs the regular interrupt 10 function. Thus the Write routine sends the same characters that appear on the display screen to the VersaBraille without affecting the operation of the Personal Computer.

APPENDIX B

CABLE CONFIGURATIONS

CABLE CONFIGURATIONS FOR THE APPLE AND THE VERSABRAILLE

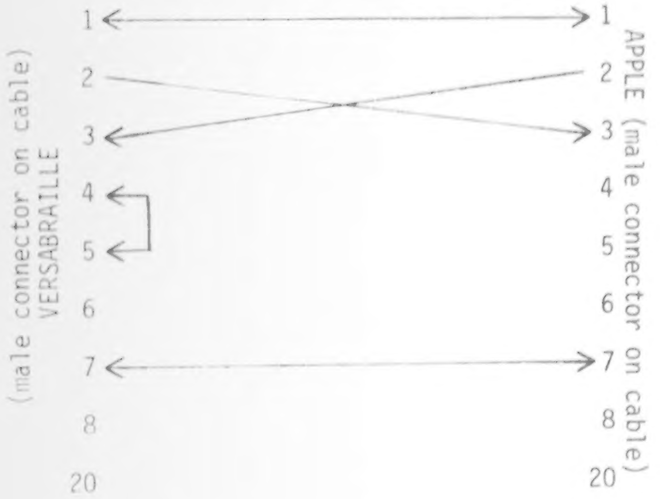
APPLE SERIAL CARD*


VERSABRAILLE
(male connector on cable)
APPLE (male connector on cable)
1
2
3
4
5
6
7
8
20
1
2
3
4
5
6
7
8
20

Duplex=Half

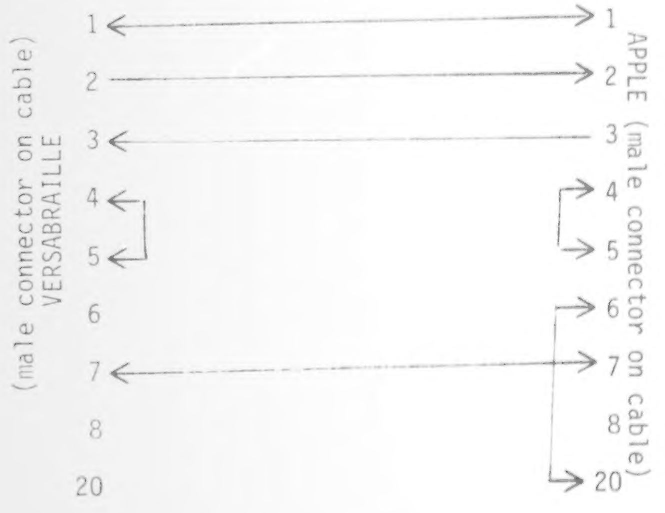
*Preferred because it supplies dual output (both CRT and braille display) and allows dual input (both braille keyboard and computer's keyboard).

APPLE COMMUNICATION CARD


VERSABRAILLE
(male connector on cable)
APPLE (male connector on cable)
1
2
3
4
5
6
7
8
20
1
2
3
4
5
6
7
8
20

Duplex = Full

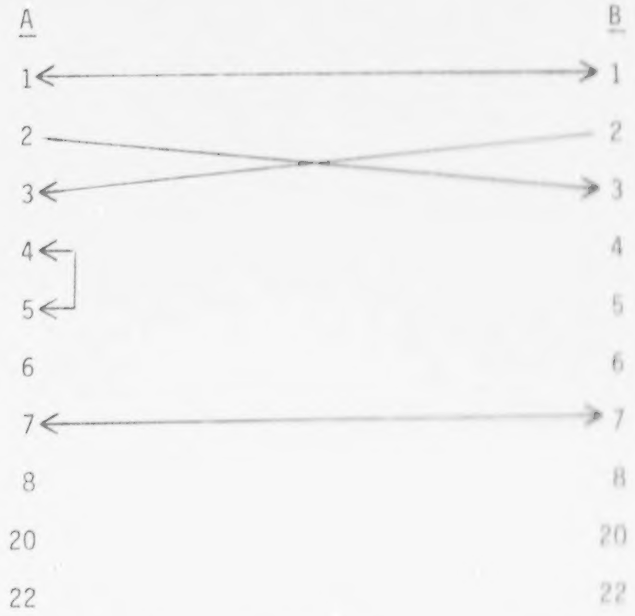
CALIFORNIA COMPUTER SYSTEMS 7710 SERIAL CARD (Versions A or D)


VERSABRAILLE
(male connector on cable)
APPLE (male connector on cable)
1
2
3
4
5
6
7
8
20
1
2
3
4
5
6
7
8
20

Duplex = Full

EQUIPMENT NAME: A VersaBraille

B TRS-80 Model III



VERSABRAILLE CONFIGURATION

Baud=300
Data Length=7
Stop bits=1
Parity=Even
Translation=C
Duplex=Full
Handshake=dtr
End of line char.in=Yes
All others default

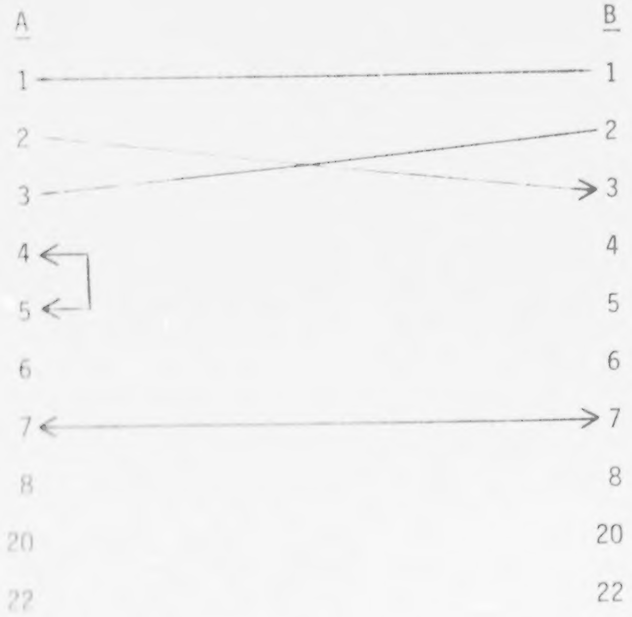
TRS-80 CONFIGURATION

LDOS Operating System by Logical Systems, Inc. must be used to provide interactive linkage.

```
SET *CL TO RS232T (BAUD=300,WORD=7.STOP=1)
FILTER *CL PR (XLATE=X'0E20')
LINK *DO TO *CL
LINK *KI TO *CL
```

EQUIPMENT NAME: A VersaBraille

B TRS-80 Model I



VERSABRAILLE CCP's
Baud=300
Data Length=7
Parity=even
Stop bits=1
Translation=C
Duplex=Full
Handshake=dtr
End of line char.in=Yes
All others are default

TRS-80 CONFIGURATION

*** VTOS Operating system must be used to provide *** interactive linkage.

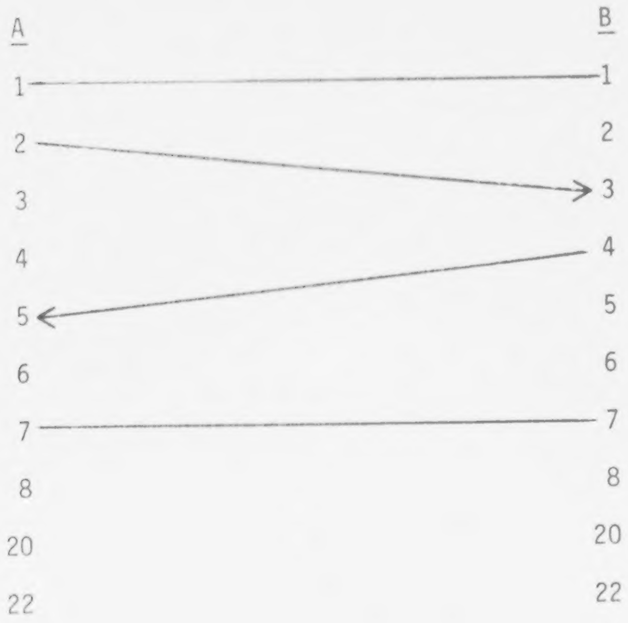
```
SET *CL TO RS232C (BAUD=300,WORD=7,STOP=1)
LINK *DO TO *CL
LINK *KI TO *CL
```

Term-Comm switch set on Comm

*** VTOS RS23C driver was customized to filter out the command prefix(Hex OE) which was sent after each carriage return. by VTOS.

EQUIPMENT NAME: A VersaBraille

B Olympia ES 100 KRO



Configure typewriter and VersaBraille overlay with matching Baud rates.
Other CCP's for VersaBraille

Hard Copy Overlay
Data length=7
Stop bits=1 or 2
Parity=N
Translation=#1
Line Length=72 or 80
Page Length=60p
all others default

CONFIGURATION CONTROL PARAMETERS (CCPs) FOR THE VERSABRAILLE

	Apple Serial	CCS 7710(A or D)
Baud Rate	300	300
Data Length	8	8
Parity	None	None
Stop Bits	2	2
Translation	C	C
Line Length	80	80
Page Length	0	0
CI	SP	
Carriage Return Delay	0	0
End of Transmission	eot	eot
Duplex	half	full
Handshake	dtr	dtr
Received Data	no	no
End-of-Line Character In	yes	yes
End-of-Line Character Out	cr	cr
Acknowledge	no	no
Data Signal Ready	no	no
Carrier Detect	no	no

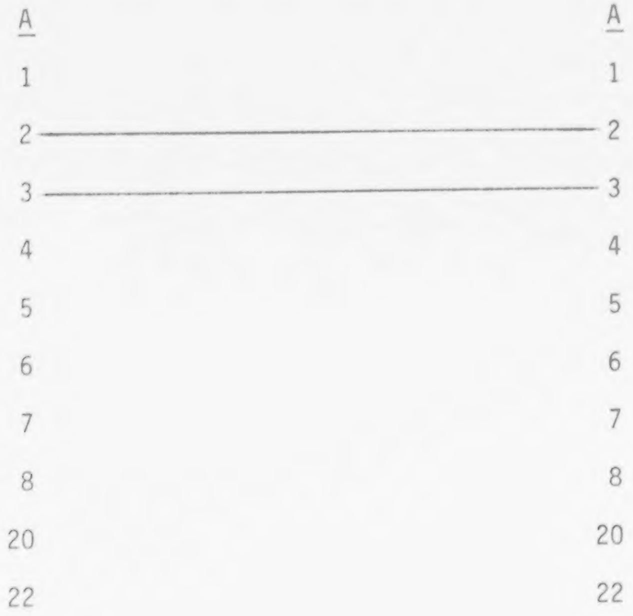
SSC for VersaBraille

SW1 -	ON	OFF	OFF	ON	OFF	ON	OFF
SW2 -	ON	OFF	ON	ON	OFF	OFF	OFF

EQUIPMENT NAME: A Microbrailler (HA software)

B Apple (SSC) printer

For male connector on MB - DTE - mode 2



Dip Switches on MD - Left to Right - on-on-on-off off off on off
SW2 - on-on-on-off off off off off
SW1 on SSC - on off off on off on on
SW2 off off on on off off off

on Microbrailler use command e2mi

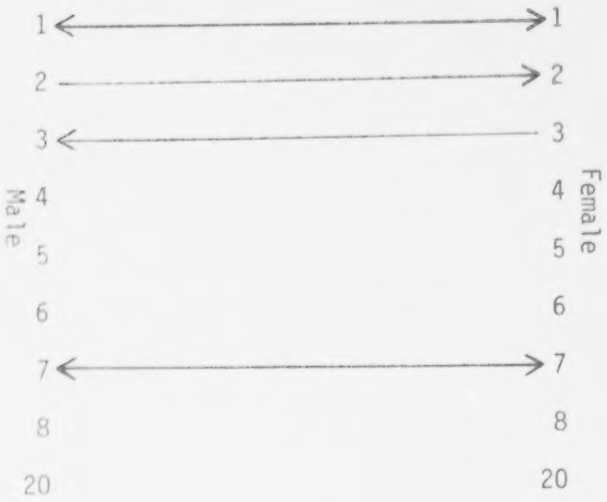
for female connector on MB - DCE - mode 3

cross wires 2 and 3
use command e3mi

(at this time our MB uses DC1/DC3 handshaking)

APPLE CONFIGURATIONS FOR Maryland Computer Services - Total Talk

APPLE SERIAL CARD - Slot #1

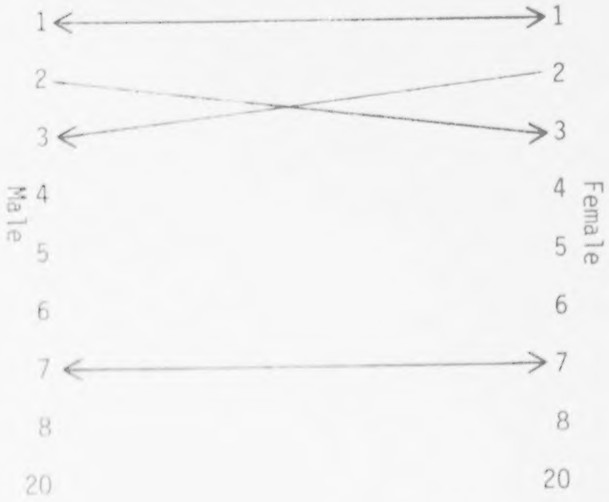

Male
1
2
3
4
5
6
7
8
20
Female
1
2
3
4
5
6
7
8
20

Duplex = Half

Straps = bCghxz

Lengthy transmissions will cause some output to be skipped when synthesizer falls behind (Omissions appear as "delete.")

APPLE COMMUNICATION CARD - Slot #4

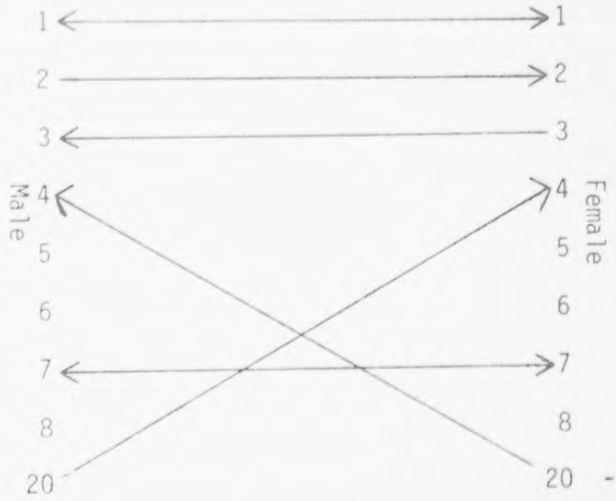

Male
1
2
3
4
5
6
7
8
20
Female
1
2
3
4
5
6
7
8
20

Duplex = Full

Straps - bCgHxz

Lengthy transmissions will cause some output to be skipped when synthesizer falls behind. (Omissions appear as "delete.")

*CCS 7710D SERIAL CARD - Slot #5


Male
1
2
3
4
5
6
7
8
20
Female
1
2
3
4
5
6
7
8
20

Duplex = Full

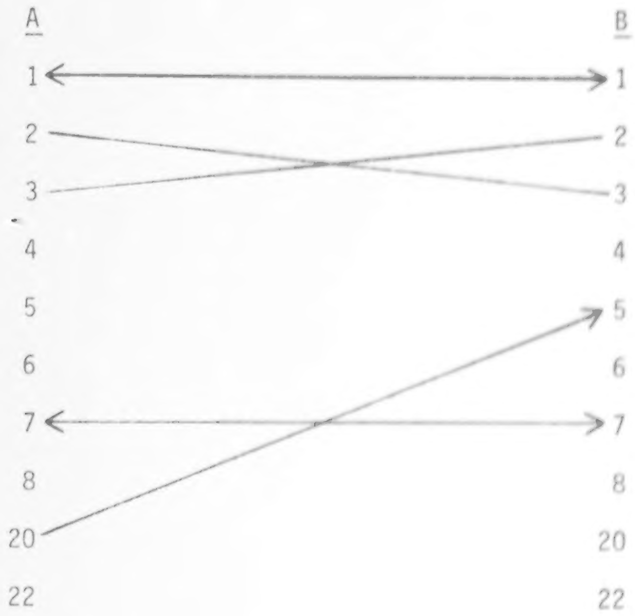
Straps = bCgHXZ

Handshake = etx (x must be lower case)

D *Preferred because of Handshaking, CRT enable, NH

EQUIPMENT NAME: A Maryland Computer Service - Total Talk

B TRS-80 Model III



TRS-80 CONFIGURATION

LDOS operating system from Logical Systems Inc. must be used to provide proper handshaking

```
SET *CL TO RS232T (BAUD=300, WORD=7,STOP=1,CTS)    ENTER
```

```
FILTER *CL PR (ADDLF)     ENTER
```

```
LINK *DO TO *CL      ENTER
```

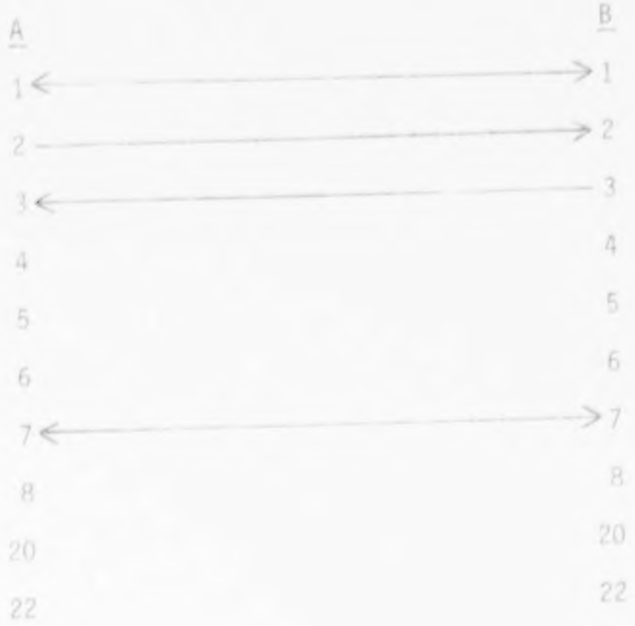
```
LINK *KI TO *CL      ENTER
```

TOTAL TALK CONFIGURATION

```
BAUD=300,,DUPLEX=FULL,STRAPS=bCgHXz,HANDSHAKE=etx
```

EQUIPMENT NAME: A Maryland Computer Services - Total Talk

B TRS-80 Model I



TOTAL TALK CONFIGURATION

```
300 Baud,None (0), Full,bcgHXz,etx
```

TRS-80 CONFIGURATION

```
Term-Comm switch on Comm
SET *CL TO RS232C (BAUD=300,WORD=8,STOP=1)
LINK *DO TO *CL
LINK *KI TO *CL
```

Terminal cannot keep up at 300 Baud and connecting the CTS line creates further problems. (See TYPE 'N Talk-TRS-80 Model I sheet). Their are two solutions if these two pieces of equipment need to be interfaced for lengthy transmissions.

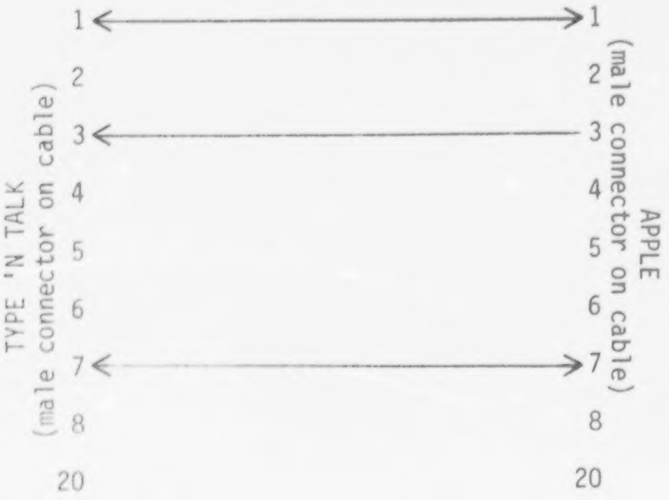
1. Change both pieces of equipment to 75 Baud
2. Change Set statement on TRS-80

   ```
   (SET *CL TO RS232C (BAUD=300,WORD=8,STOP=1,LDLY=1500)
   ```

   This creates a delay following every carriage return and gives the Total Talk time to catch up.

CABLE CONFIGURATIONS FOR THE APPLE AND THE VOTRAX TYPE 'N TALK

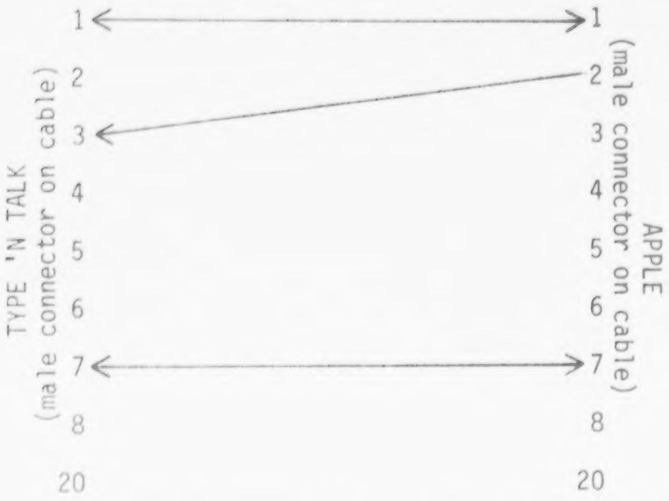
APPLE SERIAL CARD


TYPE 'N TALK
(male connector on cable)
1
2
3
4
5
6
7
8
20
APPLE
(male connector on cable)
1
2
3
4
5
6
7
8
20

Lengthy transmissions will cause some output to be skipped when synthesizer falls behing. (No handshaking)

Requires cable to speaker

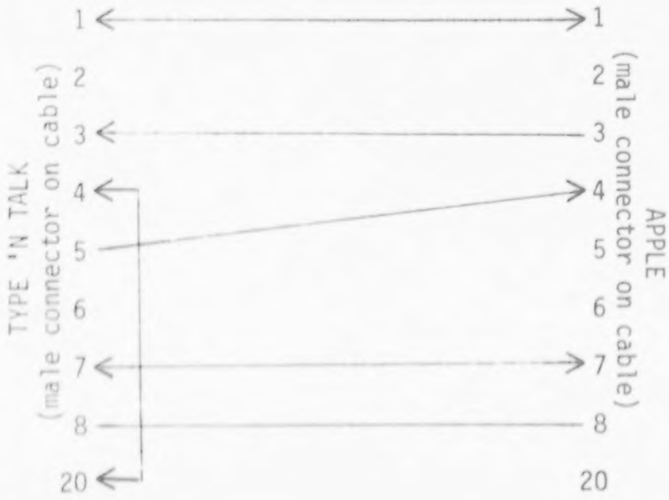
APPLE COMMUNICATION CARD


TYPE 'N TALK
(male connector on cable)
1
2
3
4
5
6
7
8
20
APPLE
(male connector on cable)
1
2
3
4
5
6
7
8
20

Lengthy transmissions will cause some output to be skipped when synthesizer falls behind. (No handshaking)

Requires cable to speaker

CALIFORNIA COMPUTER SYSTEMS 7710 SERIAL CARD (Versions A* or D**)

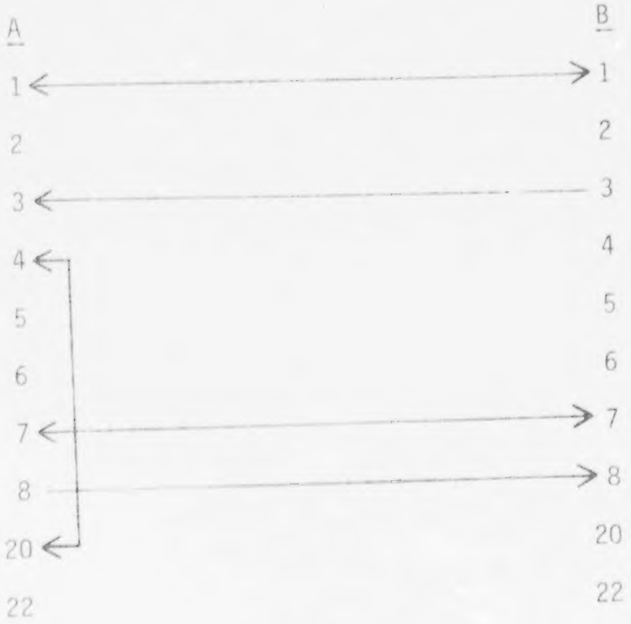

TYPE 'N TALK
(male connector on cable)
1
2
3
4
5
6
7
8
20
APPLE
(male connector on cable)
1
2
3
4
5
6
7
8
20

**First choice because of handshaking and output to the computer's CRT
*Second choice - handshaking, but no output to computer's CRT

Same cable works for SSC - printer made with Normal CTS

EQUIPMENT NAME: A Votrax Type 'N Talk

B TRS-80 Model I



TYPE 'N TALK CONFIGURATION
300 BUAD

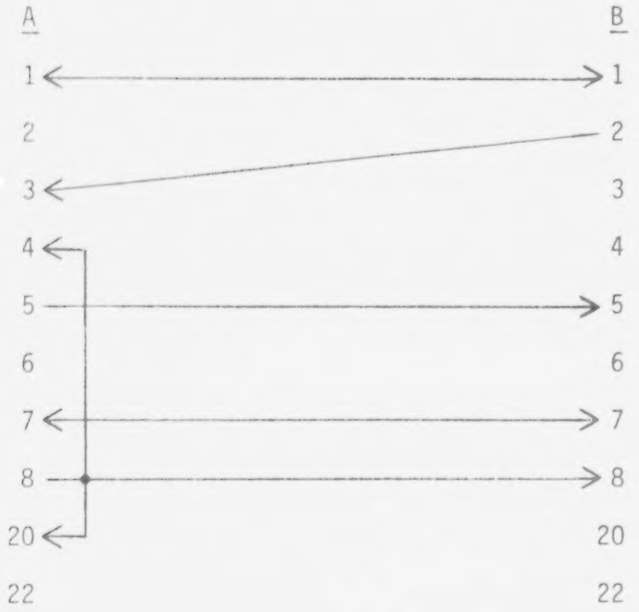
TRS-80 CONFIGURATION
Comm-Term switch on Comm
VTOS Operating system must be used to provide interactive linkage and handshaking.
SET *CL TO RS232T (BAUD=300,WORD=8,STOP=1,CTS)

With CTS set. the screen will display only the line being transmitted. When butter was full, the message would be displayed "RS232 device not ready, 'X' to exit 'N' to send anyway." Data being transmitted was lost during the time this message was displayed. Lowering the baud rate to 75 avoided the "not ready" message but the time lag following CR was proportionately longer. Using the command LINK *DO TO *CL, the busy message is both displayed and transmitted. At 300 baud, this procedure will tie up the system indefinitely.

ROUTE *PR TO *CL used with LPRINT probably would be effective but would require program modifications.

EQUIPMENT NAME: A Votrax Type 'N Talk

B TRS-80 Model III


A
1
2
3
4
5
6
7
8
20
22
B
1
2
3
4
5
6
7
8
20
22

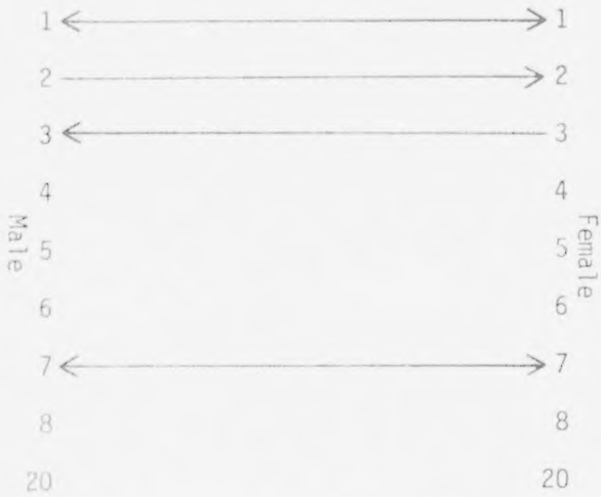
TYPE 'N TALK CONFIGURATION
300 Baud

TRS-80 CONFIGURATION
LDOS Operating System by Logical Systems, Inc. must be used to provide interactive linkage.

```
SET *CL TO RS232T (BAUD=300,WORD=7,STOP=1,CTS)
LINK *DO TO *CL
```

APPLE CONFIGURATIONS FOR LED - 120 Braille Line Printer

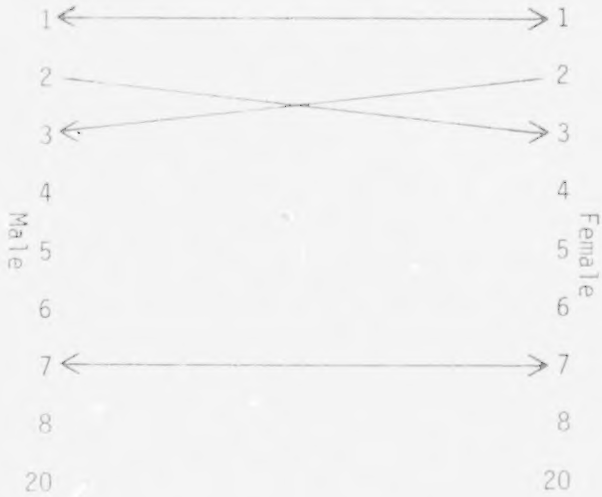
APPLE SERIAL CARD - Slot #1


1 1
2 2
3 3
4 4
Male
5 5
Female
6 6
7 7
8 8
20 20

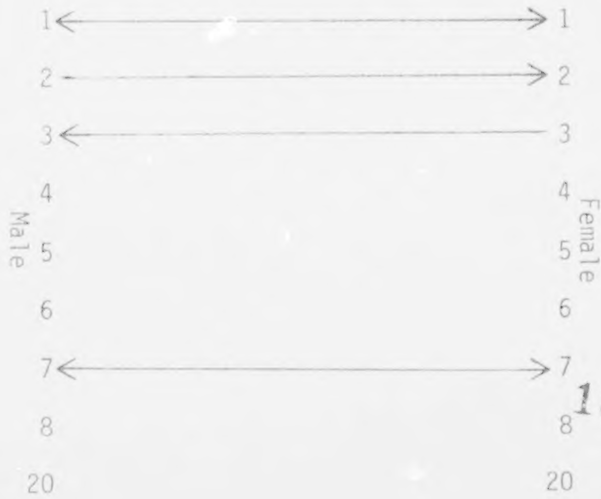
Can operate at baud rates 110-300-1200

Cable works with SSC also

APPLE COMMUNICATION CARD - Slot #4


1 1
2 2
3 3
4 4
Male
5 5
Female
6 6
7 7
8 8
20 20

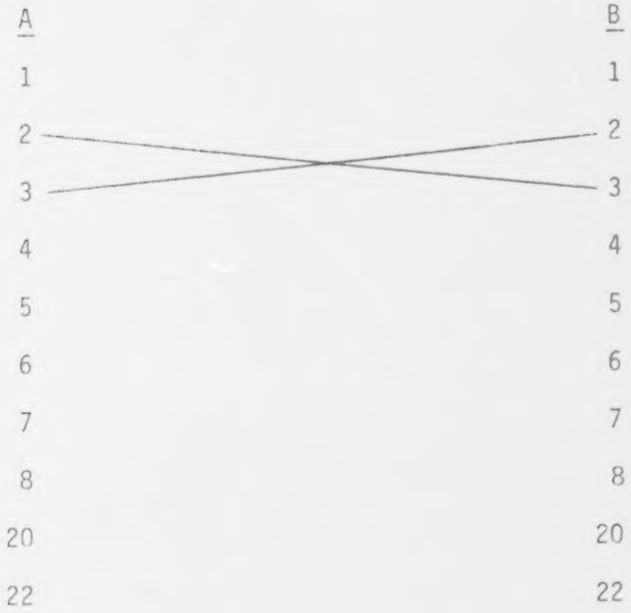
CCS 7710D SERIAL CARD - Slot #5


1 1
2 2
3 3
4 4
Male
5 5
Female
6 6
7 7
8 8
20 20

Can operate at baud rates 110-300-1200

EQIUPMENT NAME: A VersaBraille

B LED-120

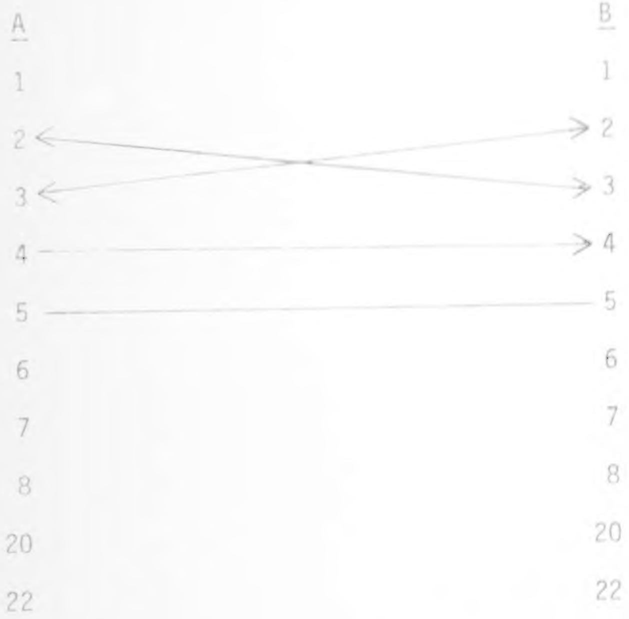

A
B
1
1
2
2
3
3
4
4
5
5
6
6
7
7
8
8
20
20
22
22

P2C overlay parameters (CCPs)

b	300
d	8
p	N
s	1
t	1
ll	40
pl	25
ci	y
or	8
et	eot
dx	f
hs	dc3
ai	N
co	CR (CRLF for double space)
ak	N
dci	N

EQUIPMENT NAME: A Braillex

B Apple via Apple Serial Card


A
1
2
3
4
5
6
7
8
20
22
B
1
2
3
4
5
6
7
8
20
22

182

EQUIPMENT NAME: A Apple

B Cranmer Modified Perkins

SUPER SERIAL CARD

A	B
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
20	20

Handshake for Perkins
Jumper Block on Terminal

300 Baud (CMPB from Maryland Computer Services)

SW1

	1	2	3	4	5	6	7
on	.			.		.	
off		.	.		.		.

SW2

	1	2	3	4	5	6	7
on	.				.		
off		.	.	.		.	.

9600 Baud (CMPB from Raised Dot Computing)

SW1

	1	2	3	4	5	6	7
on				.		.	
off	.	.	.		.		.

SW2

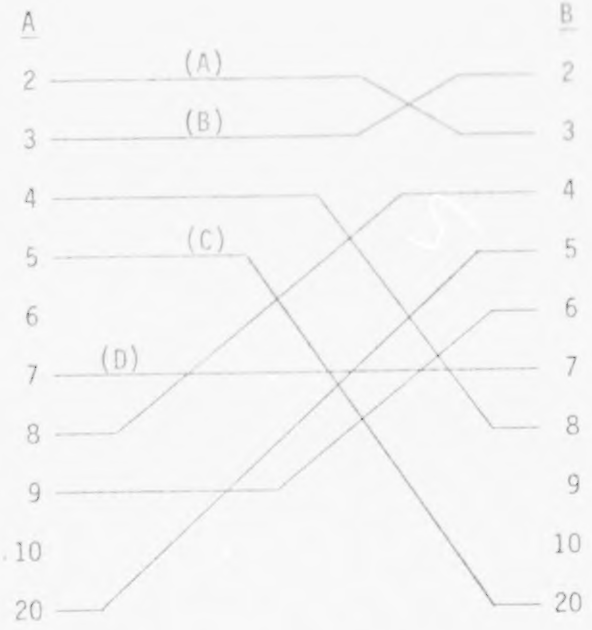
	1	2	3	4	5	6	7
on			.	.	.		
off	.	.				.	.

When setting up a Braille-Edit "configuration" to print to the CMPB, enter a "B" for type of printer.

Put paper in CMPB; turn on; enter H-chord, H; R-chord, R.

EQUIPMENT NAME: A VersaBraille

B IBM-PC



NOTES: To use VersaBraille model P2C with PCBRAILLE, only wires (A), (B), and (D) are required. A 25 pin FEMALE "D" connector is needed on both ends of the cable.

To use VersaBraille model P2 with PCBRAILLE, wires (A), (B), (C), and (D) are required. A 25 pin MALE "D" connector is needed on the VersaBraille end and a 25 pin FEMALE "D" connector is needed on the IBM-PC end.

APPENDIX C

INSTRUCTIONAL MODULES FOR BEGINNING MICROCOMPUTER AND ACCESS TECHNOLOGY SKILLS FOR VISUALLY IMPAIRED STUDENTS

ACKNOWLEDGMENTS

Instructional Modules for Beginning Mocrocomputer Skills and Access Technology for Visually Impaired Students

The Instructional Modules for Beginning Microcomputer Skills and Access Technology for Visually Impaired Students are a major product of the project entitled "Research on Multi-Media Access to Microcomputers for Visually Impaired Students." We acknowledge with gratitude the contributions of many people to these modules.

The initial work was begun in a preceding project entitled "Paperless Braille Recorders and Microcomputers for Blind Youth" with Michelle Bourgeois as project manager. Using the TRS-80 Model I microcomputer, research assistant Jane Gray developed and tested the first instructional module as a part of her master's degree thesis entitled "A Pilot Study of an Introductory Course on the TRS-80 Microcomputer for Visually Impaired Students." Work on an expanded set of TRS-80 modules was undertaken by Michael Young, Ms. Bourgeois's successor, and research assistants Susan Williams and Troy Boyd.

The staff of the project Research on Multi-Media Access to Microcomputers for Visually Impaired Youth redesigned and rewrote the modules including instructions for the interface of the Apple II Microcomputer with state-of-the-art access technology. The current version of the modules was developed by Michael Young, project manager, Susan Williams, computer programmer, and Anna Bradfield and Richard Long, research assistants.

A number of individuals and visually impaired students on and off campus also contributed substantially through field trials and expert review. Those participating in field trials include Phyllis Brunken and students at the Nebraska School for the Visually Impaired; Bill Schenk and students at the Tennessee School for the Blind; Richmond Marcy and students at the Kentucky School for the Blind; Pat Carpenter and students in the DeKalb County, Georgia, Public Schools; and Frank Irzyk and students at the New York Institute for the Education of the Blind. Those contributing to review include Cathy Mack, Mark Demuth, and LaRhea Sanford who is making the modules a focus of her doctoral dissertation.

As these acknowledgments indicate, many individuals and groups have contributed substantially to the development of the instructional modules. We cannot list them all by name, but we thank them for their efforts.

Those of us who continue to work directly with the project are responsible for weaknesses or shortcomings in the modules. We will be grateful for suggestions for improvements.

We believe and fervently hope that the modules will contribute significantly to making the benefits of microcomputers available to visually impaired students.

January 20, 1984

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INTRODUCTION to MODULES ONE, TWO, and THREE

Why Microcomputers for Visually Impaired Children?

These training materials were developed with a belief that the many benefits of microcomputer use can be extended to school-age children who have visual impairment, including those who are severely visually limited or totally blind. These benefits include the use of the microcomputers as a source of leisure time activity, as a means of instruction, and as an aid in home management (i.e. budgeting and banking). Use of microcomputers can also serve to familiarize visually impaired students with the growing number of career opportunities in computer-related fields. This training package was developed to provide teachers and other professionals with a systematic means of introducing students to operating and programming microcomputers, and to acquaint both teachers and students with their educational, vocational, and avocational uses.

What Skills Do I As The Teacher Need To Use This Training Package?

We expect that many users of this training package will have a working knowledge of operation of the Apple II Plus or other microcomputers. For teachers unfamiliar with the operation of the microcomputer equipment and its potential usefulness as a teaching and recreational tool, we recommend that you go through Modules One and Two yourself prior to introducing the student to the microcomputer. This will orient you to the operating procedures of the equipment, and will give you an idea of the types of microcomputer software available so that you can select software programs which you believe will have the greatest appeal for the students you are teaching. This prior exposure will also help you know how to correct errors which occur as the student learns the procedures of operation.

What is Learned in Module One?

This microcomputer training package is divided into three modules. Module One provides the student with an introduction to the fundamentals of microcomputer operation, and enables the student to gain an idea of the uses to which microcomputers can be put. This Module emphasizes the procedures required to get the microcomputer operating, rather than a conceptually sophisticated understanding of exactly how the microcomputer works. Upon completion of Module One, the student will be familiar with the major components of the Apple II Plus and will be able to safely power-up the microcomputer, access a simple program, and then deactivate the microcomputer.

What is learned in Modules Two and Three?

Module Two provides a description and instructions for the use of access technology which can be helpful in allowing visually impaired students to use the microcomputer without assistance from others. Access technology for blind students includes cassette braille, voice synthesis, and other types of devices.

Module Three focuses on teaching the student the BASIC (Beginner's All-purpose Symoblic Instructional Code) language. Specific programming terms are introduced (e.g. Print and List), along with sample exercises.

What Software or Programs Should I Introduce First and How Will My Learner Interact with the Microcomputer?

As mentioned earlier, microcomputers can serve a number of educational, vocational, and avocational functions. Generally the first programs that students learn to run are those which enable them to play simple games. There are some game programs which require the student to respond to graphics presented on the video display. The "TIC TAC TOE" program is an example of a graphically presented computer game. Other programs present mainly text, such as the "ANIMALS" program. Included in this training package is a diskette with several recreational and instructional programs. For Module One, the type of program you choose to aid in the introduction of the microcomputer to the student must match both the student's type and degree of residual vision and his/her level of reading proficiency. Many pupils, for example, will have sufficient vision to play a game presented graphically on the video display. For those students who are unable to read the characters or see the graphics on the display you will probably want to use a word game program, such as "ANIMALS" and you will want to link the microcomputer to a voice synthesizer in order to allow the student direct access without the use of a reader.

NOTE: We believe that direct "communication" between student and microcomputer is important from the beginning of training; and thus, we suggest that you use programs and access devices which allow the student to work without a reader. Students may require the assistance of the teacher in typing their responses to the questions asked during the game. You may also have to assist the pupil in activating the voice synthesizer (see Module Two).

How is Mastery of Material Evaluated?

Each Module consists of step-by-step procedures for operation of the microcomputer, followed by a mastery test. Mastery of the material in each Module is confirmed by testing the student to determine if he/she has reached criterion on the mastery test(s). Criterion for completion on each test is a score of 100%. Each test may be retaken as many times as necessary to reach criterion. The entire test should be given each time, NOT just the items which were failed in previous testings. Instructions for administration of the tests are provided on the test forms.

How Much Instructional Time will Be Necessary to Complete the Three Modules?

The pacing of instruction will obviously depend on the student's ability to understand your instructions and the student's reading and computation skills. We recommend that you begin with Module One unless the student can successfully complete the Module One Mastery Test. Some students may be able to start with Module Two. Give the Module One mastery Test first if the student has had prior microcomputer experience.

We have found that individual instruction is usually required during Module One. Modules Two and Three assume that the student has a greater level of reading, computational and conceptual skills; thus, the teacher has greater flexibility in selecting the format of instruction. Copies of these materials can be given to the student to read and can be used in Modules Two and Three to guide students in self-paced instruction or as a means of review prior to taking the Mastery Test. Groups of students may find it helpful to work together during Modules Two and Three. We recommend that students have at least one hour sessions for learning and practice.

BEFORE YOU BEGIN.....

Setting up Equipment

Instructions for hooking up the Apple II Plus microcomputer or other microcomputer systems and the peripheral devices are provided by the manufacturer. The material found in Module Two will assist you in effectively using the access technology most suited to your student's needs. We suggest that the voice synthesizer be used in Module One with totally blind persons and with students who are unable to read the visual display.

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In order to set up your microcomputer, you will need:

1. A firm working surface upon which the system and other peripheral devices can be placed (a desk or table top). Ideally, it should be possible for the operator to place their feet beneath the work surface.

2. A work surface at least 36" X 30" in size, with a 24" clearance above it.

3. Two or more 120 volt AC outlets located within a few feet of the rear of the work surface.

4. A voice synthesizer linked to the microcomputer (if needed).

5. A comfortable seat which is high enough (possibly adjustable) for the student to easily reach the video display and microcomputer keyboard.

6. Adequate lighting, preferrable overhead lighting, for the work surface.

There are a number of possible ways that you can lay out the Apple II Plus. There is, however, one basic configuration you should use, with modifications to be made as needed depending upon your student's needs and the peripheral devices you choose to interface with the microcomputers. We recommend that the visual display be placed on top of the Apple II Plus and both devices should be located in front of the operator (use of larger visual display monitors will require different set-ups). The disk drive(s) should be placed within the student's reach to either the right or left of the microcomputer. Typically, the voice output device you may be using (e.g. the Type-N-Talk or Echo II) will be small enough to be placed on top of the video display. We suggest that you plug all equipment into a single power strip, as this allows all equipment to be turned on and off by one switch. Before plugging any component into the power strip, first make sure the power strip is off, then turn the power control switch of each system component to the "ON" position and insert their plugs into the sockets of the power strip. Be sure to have the power strip and wires from the other components located to the rear of the system so that all of the wires will safely be out of the way of the user.

ABOUT DISKS. . .

Storing Disks

Make sure that you have a container for storing your disks. You may choose to use the box that the new disks came in or some other more permanent storage container. The disk storage container should be located close enough so that the seated microcomputer operator can easily reach it, but should be at least 12 inches from the system. Each of the electronic devices in the system produces its own magnetic field. Direct exposure of a disk to such fields, other than when the disks are properly located in the disk drive(s) may partially or fully erase the information stored on the disk(s).

Handling and Labeling Disk

Each disk should have a braille and a large-print label. When purchased, most disks have a label located in the upper left-hand corner. If the disk has only one side for recording, the side with the label is the recording side. The disk should always be handled by placing the thumb of one hand on the face of the label and using the index finger to support it from below.

CAUTION: It will not damage the disk to handle it by its edges, but at no time should you touch the exposed magnetic surface located in the center of the open slots.

Rather than attempting to list on the disk label the names of all programs located on the disk, it is simpler to give each disk a number. Put this number on the label in large print and in braille. You can make the braille label using Dymo-type labeling tape which is 1/2" or smaller. Each disk is enclosed in a protective envelope. Each protective envelope should have the same number as the disk found inside. The programs contained on the disk can be listed on the protective envelope. Use abbreviations to save space, if necessary. Braille labels can be placed on the envelope as well. This system can enable the student to locate a program if he/she knows on which disk the program is stored. If the student does not know which disk he/she wants, the student can read the directory printed on the disk envelope and search each until he/she locates a program of interest. You are encouraged to develop a system which meets your particular needs.

PREINSTRUCTION CHECKLIST FOR TEACHERS

Student Module One

1. Is all equipment plugged into one power strip so that it all comes on or can be turned off with the flick of one switch?

2. Is the equipment arranged so that all parts are easily accessible and not likely to be accidently damaged?

3. Are all wires and plugs located safely out of the user's way?

4. Has all equipment been tested to assure it is working properly?

5. Is a "dummy" disk available for the student to tactually explore and examine without causing damage to a good disk? (A slit along the top of a bad diskette will allow removal of magnetic film and examination of lining of diskette cover.)

6. Are disks labeled in braille and large print according to some reference system?

7. Are the instructional materials needed for this session handy?

8. Does the student have entry level typing skills?

9. For students who cannot read the screen, have the voice output device connected and operating to allow independent access to the microcomputer strarting from the student's first exposure to the system.

MODULE ONE

Introduction to Operation of Apple II Plus Microcomputer System

Purpose

The objective of this Module is to familiarize the student with the major components and features of the Apple II Plus microcomputer system, so that the student can independently access microcomputer programs. Mastery of this Module will be demonstrated by passing the Module I performance test at a criterion level of 100%.

Goal

The student will be able to correctly power-up, interact with, and deactivate the Apple II Plus in order to play simple microcomputer games. Mastery of these skills will provide a foundation for further microcomputer learning experiences introduced in Modules Two and Three.

Module Objectives

After completion of this Module, the student will be able to:

1. locate and name the major components of the Apple II Plus microcomputer,
2. power-up the Apple II Plus microcomputer,
3. use the following program and system commands correctly in operating the system and running a program: Catalog and RUN,
4. remove disk(s) and deactivate the microcomputer,
5. state four procedures for equipment maintenance of the disks, and
6. state four procedures related to general equipment maintenance.

OBJECTIVE 1: Locate and name major components of the microcomputer

To the Teacher: Make sure that before beginning this section on the features of the microcomputer system, you have a "dummy" disk (a disk that does not contain programs and which, preferably, has been slit open along one edge to allow the mylar plastic disk inside to be removed). You will need it in order to allow the student to become familiar with the disk. Descriptions of the components of the microcomputer system are provided on pages 4 to 5. The student is required to identify each component, but is not expected to have a technical understanding of exactly how the component works. If a student's comprehension level is such that he/she can understand the definitions given, you may read them to the student as written. Before going over the components and their definitions, first insert a disk, turn on the power, and activate the voice output device, if necessary (be sure to review the procedures to power-up the Apple II Plus beginning on page 10). Introduce each feature or component listed below by first naming it. Then, have the student name it aloud as you point it out and guide the student in exploring it. Follow this basic procedure until the student can name and locate all parts of the system. To check that the student knows which component is which and where each is located, we suggest you randomly call out a name of a component and have the student identify it orally and tactually (point it out or touch it).

I. Components of the Apple II Plus System - Hardware

1. Visual Display/Monitor/CRT/Screen

The visual display is a TV-like screen for viewing information from a microcomputer. The words visual display, monitor, screen and CRT (Cathode Ray Tube) are all used to describe this piece of equipment.

2. Contrast, Brightness, and Color Controls

Control knobs like those found on a TV and used to make the background brighter or darker (Brightness), or to make the letters or characters on the screen brighter or Darker (Contrast). If the monitor is a color monitor it will also have tint and color level controls. NOTE: Have the student adjust the brightness, contrast, and color controls to suit his/her visual preference (these will be different for each type monitor).

3. Keyboard

The keyboard is similar in appearance to a typewriter keyboard. This device allows communication between the user and the microcomputer. NOTE: Have the student explore the keyboard and press some of the letter keys so that he/she can see how the keyboard works and where it is located in reference to the video display and disk drives.

4. Disk (Sometimes called diskette or floppy disk)

A disk is a flat round magnetic object permanently enclosed in a square plastic jacket. It is similar in function to the magnetic tape cartridges used in cassette tape recorders. When purchased, each disk has a protective paper envelope similar to that found on record albums. Information may be permanently stored on a disk and quickly retrieved for use by the microcomputer. To enable the student to gain an idea of what a disk is like, have the student remove the "dummy" disk from the disk storage container. Note the labeling information on the protective envelope. Explain this to the student and instruct the student in the handling of the disk according to the instructions presented earlier on Handling and Labeling Disks (page 5). The student should touch the part of the dummy disk which are exposed (center and slot just below the center). Tell the student that, in the future, he/she is not to touch these exposed surfaces on all other disks. Be sure that the student knows that he/she is holding the disk properly if he/she is grasping the disk by the label using a pincer grip (thumb on top of the label); and the notch is located on the left edge. Practice removing the disk from storage and replacing it in the proper location.

5. Disk Drive

This device allows a microcomputer to read and/or store information on a magnetic disk. The disk drive is somewhat analogous in function to a tape recorder. Frequently, more than one disk drive is used as part of a microcomputer system. The drive which activates initially upon power-up is the primary drive and is referred to as drive one (1). The Apple II Plus can handle many other drives which are numbered from 2 consecutively if present. NOTE: Have the student tactually explore the disk drive and locate the door where disks are inserted. Pull out and up on the lock button to open the door. Once this has been done, remind the student that a system may use more than one disk drive but that only one of them acts as the primary drive and it controls the operation of other drives.

6. Power Strip

The power strip is a plastic or metal strip containing several electrical sockets. This strip serves as a central power source into which several microcomputer system components can be plugged at the same time. It may be necessary for the student to get up from the seat in order to touch and view the power strip. The student should explore the power strip and note the location of the ON/OFF switch, the light (if present) which goes on when the power is turned on, and the wires from the other components.

Before proceeding further, it may be helpful to have the student identify the six (6) components of the Apple II Plus system, and if practical, to explore the function of each component. You may stop the lesson here and the teacher should deactivate the system. If, however, you decide to continue, then deactivate the system and go to Objective 2. Be sure the disk is removed from the disk drive before turning off the system.

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OBJECTIVE 2: Procedures to power-up the Apple II Plus

1. Load the Disk Drive

Have the student locate and remove from the storage container the Sample Programs disk which has the "ANIMALS" program on it (provided in this package), then remove the disk from the protective envelope. Replace the envelope in the storage container. Have the student locate the opening of the disk drive. Insert the disk into the drive using the free hand as a guide. The disk will be properly in place when it is level and pressed fully to the rear of the drive. Close the door until it locks. The student should practice these procedures several times before proceeding.

2. Press the "ON" Switch of the Power Strip

Have the student make sure that the disk drive door is closed before turning the power on. Turn on the power strip (note that you can hear the drive come on). Activating the microcomputer as just described is also called "booting the diskette." The video display will light up and a cursor should appear (see #4 below).

3. Adjust Contrast and Brightness

Adjust contrast and brightness controls on the video display for the sharpest print. Even though blind students will not have direct visual access to the display, they need to be familiar with these controls, as they will be expected to know their location and function for the Module One Performance Test. They are also important for adjusting the screen for reading by the Optacon and CRT lens.

4. Cursor

The cursor is a position indicator that shows on the video display where the next character typed will appear on the screen. It looks like a flashing square on the screen. Have the student locate the cursor on the screen and proceed to introduce the special keys starting with the SPACE BAR.

Functions of Special Keys on the Keyboard

1. RIGHT ARROW

The RIGHT ARROW moves the cursor to the right, one position at a time. Have the student press the RIGHT ARROW several times and note how the cursor moves across the screen one position each time the key is pressed. Note that when using the RIGHT ARROW to move the cursor to the right the characters which the cursor moves over are not erased.

2. LEFT ARROW/BACKSPACE

Pressing this key allows you to move the cursor one position to the left so that you may change the last character (letter, number, or symbol) typed. Have the student locate this key and press it several times noting how it moves the cursor back, position-by-position. Note also that when the cursor moves over characters they are not erased. Corrections or changes are made by moving the cursor to the desired position with the LEFT ARROW and then retyping. Next, have the student press several keys and then move the cursor over them one at a time using the backspace key.

3. SHIFT

Holding this key down allows you to use a character shown on the top-half of the non-alphabetic keys (note top row keys); for example, press SHIFT and while holding it down with one finger, press the number 3 key. This will produce the number (or pound) sign (#) on the video display. Doing the same using the SHIFT and the number 1 key produces an exclamation mark (!) on the screen. Note that the non-alphabetic keys are two function keys. Also note that the SHIFT key must be held down while another key is pressed. In most applications the Apple II Plus generates only upper case letters and pressing the shift key is not required.

4. RETURN

Pressing this key signals that you have finished entering information and the microcomputer can begin processing. You may write anything you want on the visual display, but the microcomputer will not attempt to do anything with your instruction until you press the RETURN key. Have the student write his/her name and note that until he/she presses RETURN nothing will happen. In this case, the microcomputer will respond with an error message (e.g. ? SYNTAX ERROR) after RETURN is pressed.

5. CONTROL (CTRL) and CONTROL C

The CONTROL (CTRL) key is located on the far left side of the keyboard, just above the SHIFT key. It is labeled CTRL. This key operates much like the SHIFT key in that pressing this key alone has no visible effect, and its effects are obtained only if the CTRL key is held down while another key is pressed. The sequence of holding the

CTRL key, and simultaneously pressing the letter C will cause a program to stop without disconnecting the access technology. If the program is currently waiting for the microcomputer user to answer a question, it will be necessary to press the RETURN key following the CTRL C sequence. This CTRL C sequence allows a program to be restarted from the beginning by simply typing RUN or another program to be run by typing RUN followed by the name of the new program (see pp. 13-16).

6. CTRL RESET

Pressing the RESET key while holding down the CTRL key stops a program which is running, disconnects all access devices, and returns control of the microcomputer to the user. This is not the preferred way of stopping a program because it disconnects all access devices and restarting them can be time-consuming. It will stop programs that the CTRL C sequence will not stop. Since no program is loaded at this time, you can have the student press the CTRL RESET sequence and note that the microcomputer comes back with the cursor. If you will not be introducing the procedures for loading a disk program next, then the student should be instructed in deactivating the microcomputer to complete this lesson.

NOTE: Be sure to re-establish the peripheral access devices (e.g. voice output device) after RESET has been pressed.

OBJECTIVE 3: Use Commands to Run a Program

The next activity will be loading and running a disk program. You may prefer to introduce the functions of Commands first or you can introduce these in the context of teaching the student to load a disk program. The commands are listed below, followed by instructions for running disk programs.

Function of Commands

CATALOG - The microcomputer responds to this command by displaying on the video display, and any accompanying access technology, a list of all programs stored on the diskette located in the primary disk drive (1). This aids the user in determining the correct names for programs on this disk.

RUN - The microcomputer responds to this command by executing the program currently loaded in memory. When followed by a space, then the name of a disk-stored program, the microcomputer responds by loading and executing the program named, (e.g. RUN ANIMALS will load and begin the program ANIMALS).

Other Important Terms

1. BASIC - This is the computer language used to tell the microcomputer what to do: it is an acronym for Basic All-Purpose Symbolic Instruction Code. Just as English is the language in which we communicate and understand, the microcomputer understands the BASIC language. Like English, BASIC has its own grammar, punctuation, and vocabulary. Tell the student as s/he learns the grammatical rules, punctuation, and vocabulary of the BASIC computer language, it will be possible to write computer programs. Each Apple II Plus will support at least one of two types of BASIC: Applesoft BASIC and Integer BASIC. Programs written in each of these languages are identified in the CATALOG by an "A" or an "I" and by the screen prompts right bracket and greater than (>), respectively. Module 3 introduces the student to some simple BASIC commands and programming.

2. Program - A set of step-by-step instructions written in a computer language directing the computer to handle information in a particular way.

PROCEDURES FOR RUNNING A DISK PROGRAM

1. Remove the disk from its protective storage envelope by placing the right thumb on the label, keeping the disk

horizontal.

2. Raise the door of the primary disk drive, one (1).

3. Place the disk properly inside the disk drive door.

4. Lower the disk drive door until a click is heard.

5. Turn on power strip.

A greeting, and

(right bracket)

will appear on the video display.

6. For a listing of the programs available on the disk, type CATALOG and press RETURN,

(right bracket)

will appear on the video display. Remember to note the exact name of the desired program.

7. Type RUN and the name of the desired program exactly as it is spelled in the Catalog. For example, type RUN ANIMALS, then press RETURN.

Have the student practice the program running procedure several times until comfortable and let him/her play the game. If necessary, read aloud the questions shown on the video display. You can stop here and have the student turn off the microcomputer and put the disk away (see page 4) or continue and leave the ANIMALS program loaded. When the student makes spelling or spacing errors, after he/she presses RETURN, the microcomputer is likely to respond with SYNTAX ERROR. You may prefer to correct these errors at the time that they occur without going into an explanation, or you may review system commands and proper syntax with the student.

Interpretation and Appropriate Action for Error Messages

Generally whenever you get an error message such as the two below, try the procedures suggested below.

PROGRAM NOT FOUND - The microcomputer cannot find a program on the diskette with the name you have typed in. Perhaps you have spelled it incorrectly or have the wrong disk. Try consulting the CATALOG for the exact name and retype the command.

SYNTAX ERROR - The microcomputer does not understand the information typed in. Check spacing, spelling, and punctuation to be sure that what you typed in is in the correct format.

Procedure for Running the Same Program After Execution is Complete or Disrupted

From time to time, you may be using a program and either you stop the program from running or you want to restart the program after it is completed. There is an easy way to do this. If at any time you want to stop a program from running:

1. Press CTRL C. (If the microcomputer is currently waiting for the user to answer a question, it will be necessary to press the RETURN key following the CTRL C.) As a result,

```
BREAK IN ##
```

should appear on the video display and the program will stop running at the line (##) listed.

If after using CTRL C to stop the program or the program ends, and you then wish to restart the SAME program again:

2. Type RUN, and press RETURN (NOTE no name is required).

Your program will restart at its beginning.

Procedure for Running a New Program After Execution is Complete or Disrupted

If you wish to stop the execution of an ongoing program, the procedure is the same as step 1 above:

1. Press CTRL C. (If the microcomputer is currently waiting for the user to answer a question, it will be necessary to press the RETURN key following the CTRL C.) As a result,

```
BREAK IN ##
```

should appear on the video display.

If you then wish to start a different program:

2. Type CATALOG, then hit the RETURN key

3. Note the exact program name;

4. Type RUN followed by the exact name of the desired program, and press RETURN (e.g. RUN DUTCH.BAS).

This should load and start the new program.

OBJECTIVE 4: Procedures for Turning Off the Apple II Plus

1. Remove any disks from the disk drives and place them in their storage envelopes.

2. Press the "OFF" switch of the power strip.

3. Clear the work area of any extra material.

OBJECTIVE 5: Procedures Related to Maintenance of the Disks

1. Hold the disk with the thumb over the label; do not touch any part of the disk not covered by the protective plastic. Touching the exposed areas may result in part of the programs stored on the disk being destroyed.

2. Never place the disk on top of the disk drive(s), the video display, or any other electrical equipment because the magnetic fields produced by such equipment may destroy the information stored on the disk.

3. Never turn off the power with a disk still in the disk drive. This can cause a magnetic surge in the drive to erase some of the information stored on the disk. This is especially true if the power is turned off while the disk drive is still running.

4. Never open the door of the disk drive(s) until the drive has stopped running (e.g., the disk drive motor has stopped whirring and the light next to the drive door has gone out). Opening the door while the drive is running may damage the information on the disk(s). In addition, if you attempt to remove the disk from the drive before it has stopped, you may damage the disk itself because the hub which turns the disk will continue to turn and will crumple the disk as you remove it.

5. Be certain to REMOVE THE DISK(s) from the disk drive(s) and put it/them back in the protective envelope after each use. This will prevent any damage to the disk and ensure that each disk can be properly identified.

OBJECTIVE 6: Procedures Related to General Equipment Maintenance

1. Students should sign in and out on a time sheet when using the equipment. This allows the teacher to account for microcomputer use (who has been using it and when).

2. All equipment should be handled with care to promote safety for the user and prevent repair or replacement of expensive components.

3. No equipment should be moved by any student unless supervised by the teacher. Unauthorized moving can lead to damage of the equipment or injury to the student.

4. Any malfunction of the equipment should be reported immediately to the teacher so that repairs can be made quickly.

5. The students should keep all foreign objects such as food, liquids, or magnets away from the microcomputer. These objects can cause damage to the equipment.

6. When completing work on the microcomputer, the student should clear the work area of personal materials. This will assist the student in keeping track of the materials and give the next user work space.

MODULE ONE PERFORMANCE TEST

NOTE: THIS TEST IS TO BE ADMINISTERED WHILE STUDENT IS SEATED IN FRONT OF THE MICROCOMPUTER.

Instructions/Scoring Criteria

I. Locating Major Components:

The teacher should read the question to the student, read the name of each component listed one at a time, and mark the test protocol as the student responds. If the student correctly locates the component by pointing to or touching it, mark a "+" below the number corresponding to the component listed at the right. If the student does not independently locate the component, mark a "-" and physically guide the student's hands to the component.

II. The teacher should select a disk the student has never or rarely used and hand it carefully to the student after reading this question to them. The teacher should remind the student to verbalize each step before performing it. The teacher should place a number in front of each step to record the order in which the student names them. If the step is in the correct sequence, the student should be asked to perform the step, but the teacher should stop the student from performing a step if it is out of order. Incorrect answers should be recorded. The first time a student "names" a step out of the proper order, the teacher sould say something like, "No, think hard and tell me which step is next." If the student is correct, they may continue to the next step in this section. If the student gives a second incorrect answer on the same step or subsequent steps, the remaining steps are counted as "-" (fail). If the student "performs" any step incorrectly, the remaining steps are scored "-."

1. Raise the door of the primary disk drive (or 2).

2. Remove the disk from the disk jacket by placing the right thumb on the label, keeping the disk horizontal (or 1).

3. Place the disk inside the disk drive door, pushing gently until properly inserted.

4. Lower the disk drive door until a click is heard.

5. Turn on power strip.

6. For a listing of the programs available on the

disk, type CATALOG.

7. Type RUN and the exact name of the desired program, then press RETURN.

III. Correct Responses: Mark a "+" on protocol if student correctly names the command.

1. CATALOG.

2. RUN.

IV. CORRECT RESPONSES: Mark "+" or "-" on answer sheet below number. Mark "+" only if student both names and locates each key.

1. SHIFT - lower corner.

2. LEFT ARROW/BACKSPACE - row 2, second from right.

3. RETURN - row 3, far right.

4. RESET - top row, far right.

5. Cursor - "on screen".

6. CONTROL - row 3, far left.

V. Mark a "+" on protocol if these two steps are followed:

1. Press CTRL C (or CTRL C followed by RETURN if necessary.)

2. Type RUN (it would also be correct to type RUN and the exact name of the program you have just stopped from executing).

VI. Teacher should select another program on the same disk and tell the student the name of the program. The student should:

1. Press Control "C" (or CTRL C followed by RETURN if necessary.)

2. Type CATALOG and press RETURN to verify that the program is available on the disk and to determine the correct spelling and punctuation of the name.

3. Type RUN and the exact name of the program.

4. Press RETURN.

VII. The student should give the following steps in this order: (Mark a "+" on the protocol if student completes all four steps).

1. Check to see if there is a disk in the disk drive(s).

2. Remove the disk(s) from the disk drive(s) and place in storage envelope.

3. Press the "OFF" switch of the socket strip.

4. Clear the working area of any extra materials. (Student's response may imply #1 but not explicitly state it, and they may only give #2 as response. If so, ask how would you know if there is a disk in the disk drive?

VIII. 1. This error message means that the microcomputer cannot find a program on the diskette with the name as you have typed it. You may have misspelled the program name.

Get a CATALOG. Check spelling, then retype command and press RETURN.

2. This error message means that the computer does not understand the information typed in.

Check spacing, spelling and punctuation to be sure what you typed is in the correct format, then make corrections.

IX. Name and explain procedures for maintenance of the disk drives. Record a "+" on the protocol if the student correctly names any four of the five procedures.

The following responses are acceptable, in any order:

1. Hold disk with thumb over label; do not touch any part not covered by protective plastic (programs might be destroyed).

2. Never place disk on top of the disk drive, video display or any other electrical equipment (programs might be destroyed).

3. Never turn off the power switch until the disks have been removed (and especially not while the disk drive is still running because it may damage information on the disk or the disk itself).

4. Never remove the disk from the disk drive while the light on the disk drive is still on and the drive is

still running.

5. Remove disks from disk drive and put them back in their envelopes after each use (protects disks from damage).

X. Name and explain procedures for general equipment maintenance. Record a "+" on protocol if student correctly names any four of the following responses.

The following responses may be given by the student in any order (only four are needed):

1. Sign in and out on the time sheet. (Accountability; to keep track of who has been using the equipment and when).

2. Handle all equipment with care. (High cost of replacing and repairing the equipment; safety).

3. Do not move equipment without specific permission (Safety and care of equipment).

4. Report any malfunction of the equipment (Can quickly repair).

5. Keep all foreign objects away from the computer area, i.e., food, liquids, magnets (possible damage to equipment).

6. Clear work area of personal materials after use (Won't lose; won't take up space needed by next user).

TEST ITEMS

I. I am going to read a list of all the major components of the Apple II Plus that you are expected to know. Then I will read the name of one component at a time and I want you to LOCATE AND SHOW me the component I have named.

a. Floppy Disk/Disk/Diskette.

b. Video Display.

c. Disk Drive.

d. Contrast and Brightness Controls (and Color controls, if applicable.)

e. Keyboard.

f. Power Strip.

II. Now we are going to talk about loading a disk program. Using the microcomputer, please TELL me AND SHOW me the seven (7) steps you must follow to correctly run a program from a disk you have not used before. Be sure to use the correct order.

III. I am going to read the descriptions of two commands. Tell me the name of each command that I describe.

1. The computer responds to this command by displaying on the video display a list of all programs stored on the disk in the primary disk drive (1). What is the name of this command?

2. The computer responds to this command by executing the program currently loaded in the memory. What is the name of this command?

IV. I am going to read the definition of some of the special keys or terms you need to know to operate the microcomputer. After I read each definition, please NAME AND SHOW me the keys or symbols described.

1. Holding down this key allows you to use a character shown on the top-half of the non-alphabetic keys; for example, pressing this key and the number 3 key at the same time gives you the "number sign" (#) and pressing this key and the number 1 key at the same time gives you the exclamation point (!). (SHIFT)

2. Pressing this key moves the cursor one space to

the left. (LEFT ARROW/BACKSPACE)

3. Pressing this key signals the microcomputer to begin processing the information you have entered. (RETURN)

4. Pressing these keys together stops a program which is running, disconnects the access device, and returns control of the microcomputer to the person using the microcomputer. (CTRL RESET)

5. What is the name of the symbol which shows where the computer expects the next character to appear? It looks like a flashing square on the screen. (Cursor)

6. This key, when pressed at the same time as the C key, will cause a program to stop without disconnecting the access equipment. (CTRL)

V. Let us suppose that you would like to start this program again from the beginning. Show me how you would do this.

VI. Let us suppose that you want to stop this program while it is running and start a NEW program on the same disk. TELL me AND SHOW me what you would do to run the program named "--------."

VII. TELL me AND SHOW me the four steps you would follow to deactivate the Apple II Plus. Be sure to use the correct order.

VIII. 1. If you get the error message, PROGRAM NOT FOUND, what does it mean? What would you do to try to solve the problem?

2. If you get the message, SYNTAX ERROR, what does it mean? What would you do to try to solve the problem?

IX. NAME and EXPLAIN four important procedures for maintenance of the disks.

X. NAME and EXPLAIN four important procedures for general equipment maintenance.

Module Two

Access Technology for Visually Impaired Microcomputer Users

This module will provide information to visually impaired students regarding several modes of access to the microcomputer. Access devices allow the student to send and receive information without depending on the assistance of a reader. They include devices which use cassettes to record braille (e.g. the VersaBraille), the OPTACON, which permits the visually impaired student to read the microcomputer's screen (CRT) directly, and speech synthesis devices which convert the microcomputer's output to an audible voice output (e.g. the Type-N-Talk).

INTRODUCTION

Following completion of the Module One mastery test, the student will be able to independently activate the microcomputer, request a program catalog, and select and run a simple game program. The student will also be able to interpret and correct simple error messages, such as "syntax error" or "file not found". We recommend that you allow the student to have a substantial amount of practice on these Module One activities prior to beginning Module Two, as proficiency on the use of the keyboard is essential to completion of Module Two.

In this Module, the student will learn to use one or more modes of access for visually impaired students. An introduction to cassette braille devices, the OPTACON with the CRT lens, and speech synthesizers, will enable you and the student to choose which device(s) may be appropriate for individual access to the microcomputer. The student will also be made aware of all types of access technology to aid in further educational and vocational exploration. After an initial overview, more detailed instruction in the desired piece(s) of access technology will be provided. You may wish to instruct the student in one or all of the access devices. Use of the Type-N-Talk speech synthesizer, or similar speech output, will permit the student to use the microcomputer without direct supervision while instruction in the use of the other devices is ongoing.

It is very important that the instructor know how to not only operate the access device, but be very familiar with interfacing procedures. Carefully read the preinstruction checklist for Objectives Two, Three, and Four and refer to the appropriate appendices for instruction in interfacing. The devices will not work properly if all interfacing steps are not followed.

ORGANIZATION NOTE

While this module is organized with a major goal and objectives, as with Module One, some differences should be noted.

NOTE: Each student should complete ALL items of Objective One (Introduction to Access Technology), since it represents a general knowledge survey of access devices.

The student should then progress to only those objectives dealing with the piece(s) of access technology that will be used. Most students will not complete all four objectives. Each objective will have a mastery test instead of one test at the end of the Module. Criterion for completion of each objective's test is 100%.

MEANS OF INPUT AND OUTPUT

Independent use of the microcomputer by visually impaired students requires that they have a means of sending information to the microcomputer (input) and receiving information from the microcomputer (output). For sending information to the microcomputer, most students will use the typewriter-like microcomputer keyboard. The level of typing skill required will depend on the sophistication of the program. Some programs, such as drill and practice, require only a "yes" or "no" response, indicated by pressing the "y" or "n" key and then the "Return" key. Programming activities such as those in this Module and in Module Three require that the student have the ability to at least "hunt and peck" a set of instructions using the keyboard. The only other means of sending information is by using a cassette braille recorder. The cassette braille recorder is the only access device that can serve as both an input and output device (both send and receive information in braille). The other devices (OPTACON and Type n' Talk) are output devices only and require the use of the microcomputer keyboard to input information.

A WORD ABOUT LARGE PRINT

Many visually impaired students can use a standard microcomputer screen to access information in the microcomputer if the print on the screen is enlarged. In order to produce large print on the Apple II Plus microcomputer, each program can be altered by adding a subroutine (additional instructions) which will enlarge the print. A programmer must add the subroutine to the program before it will appear in large print. This alteration cannot be completed by a student who is beginning to learn about microcomputers. The visually impaired user does not need to know special commands to produce large print. S/he need only to have a program that has been altered. For this reason, we have not included large print as a separate objective of Module Two. It is discussed in Objective One's overview of access technology

A closed circuit television unit such as the Visualtek can also be used to enlarge the print directly from the microcomputer screen on the CCTV screen. Due to mechanical modifications necessary to use the CCTV in this manner, the microcomputer CRT must be used solely for large print purposes when this modification is made. Instructions for this use of the CCTV can be obtained from the manufacturer.

PURPOSE

The purpose of this Module is to introduce the student to cassette braille devices, the OPTACON and speech synthesizers as access devices for microcomputers. Students will develop skills for use of one or more of the access devices to enable them to independently use the microcomputer.

GOAL

The student will be able to describe the primary types of access devices. Students who are unable to read either regular or large print on the CRT will independently operate the microcomputer using the mode of access selected by the student and teacher. The student will independently send and receive information using the access device(s) and the microcomputer.

MODULE OBJECTIVES

After completion of this Module, the student will be able to:

1. locate, name, and describe the four types of access technology for the microcomputer, and

2. use cassette braille devices to access microcomputers, and/or

3. use the OPTACON to access microcomputers, and/or

4. use synthesized speech to access the microcomputer.

PREINSTRUCTION CHECKLIST FOR TEACHERS

Student Module Two
Objective One

1. Is the equipment arranged so that all parts are easily accessible and not likely to be accidently damaged?

2. Are all wires and plugs located safely out of the user's way?

3. Has all equipment been tested to assure it is working properly (Apple II Plus Microcomputer, VersaBraille, OPTACON, Type-N-Talk)? NOTE: all equipment must be available to properly complete Objective One.

4. Are all instructional materials needed for this session handy (sample disk and copies of module needed)?

OBJECTIVE 1: Locate, name, and describe the four types of access technology for the microcomputer.

In order to facilitate instruction of this objective, the teacher should have the access equipment (cassette braille device, OPTACON, and speech synthesizer) checked and ready for demonstration. This will require example programs which are available on the sample disk enclosed with this module. Set up one device at a time (unless more than one microcomputer is available) and instruct the student in the major components of the device and it's operating principles. Once the student has mastered basic knowledge about the device, move on the the next piece of access technology. You may wish to go over the questions on the Objective One test dealing with the device you have just discussed, as a review. We suggest, however, that the test be given in its entirety after completion of the objective.

Introduce the student first to the access device and its features as described below. Allow the student to explore the device independently and then guide his/her hand to the various components. Name the component and explain its function. After instruction, the student should be able to locate and explain the function of the selected components independently. When the parts of the device have been mastered, explain the input and output modes of the device. Let the student input information and read the output when possible (some students will not be able to read with the OPTACON but can examine the display). You will need to assist the student since not all of the information necessary to operate the devices will be provided during this objective. Use a program on the disk provided with this Module to assist you in instruction. Once the student has learned the components, insert the disk and prepare the program for use. The student should have only a cursory exposure to the program to demonstrate the input and output modes.

I. Features and Operating Principles of the VersaBraille (cassette braille device) as an Access Device for the Microcomputer.

1. The VersaBraille, manufactured by Telesensory Systems Inc., is one type of cassette braille device. This device has a number of valuable features for the blind student. It stores braille input on a standard cassette tape and can send information from its memory or the tape to a microcomputer or to a ink print or braille printer. It can also be used by itself ("stand alone" capability) to store braille information and has a number of editing features which can be useful in proofing text and changing portions

of text. Information that is put into the microcomputer with the VersaBraille as the input mode, requires the use of uncontracted computer braille. This system is very similar to Grade I braille.

2. Major Components of the VersaBraille

The VersaBraille has a tape deck, ten keys, two control levers (speed and volume), a twenty cell braille display and advance bar and Perkins-type keyboard. To meet this subobjective (2) it will be necessary to learn the location of only the following components:

a. The Tape Deck

The tape deck for the VersaBraille is located on the left side in the center of the machine. Its operation is similar to a regular cassette machine. The tape is inserted with exposed tape toward the user. The tape holder is opened by the eject button just above the upper left corner of the deck. The holder will not open unless the machine is turned on.

b. The Braille Display and Advance Bar

The twenty cell braille display is located on the center right of the device. The advance bar is directly above the display stretching it's entire length. The braille characters are formed by pins that are raised and lowered automatically. Once one line has been read, the user presses the advance bar to clear the present characters and cause the next line to appear.

c. Braille Keys and Space Bar

The braille keys are on the lower right hand corner. They are two sets of three keys with a space bar between and slightly below the keys. The braille keys and space bar are operated like a Perkins braille writer keyboard.

3. Input and Output Modes for the VersaBraille

a. Input mode

In order to put information into the microcomputer, the student uses the braille keys and space bar. Braille written on the keyboard is then translated into signals the microcomputer can process (ASCII code). The information will appear in braille on the braille display, and on the CRT in print when used with microcomputers.

b. Output mode

The VersaBraille accepts information sent from the microcomputer and translates it into braille which appears on the braille display. When one line has been read, the student presses the advance bar and the next line appears until the end of the transmission when a beep is heard.

II. Features and Operating Principles of the OPTACON as Access Technology for the Microcomputer

1. The OPTACON (Optical to Tactile Converter) is a device manufactured by Telesensory Systems Inc. (T.S.I.). It converts print into a tactile medium using a small hand-held camera. The camera is placed over the printed letter and the shape of the letter is formed by vibrating pins on the tactile display. The user rests his/her finger on the tactile display and feels the shape of the letter. The user of the OPTACON must be able to recognize letter shapes and be trained in its operating principles.

2. Features of the T.S.I. OPTACON

a. The Camera

The camera is a rectangular device with a small lens on one side. It is connected to the tactual display device by a wire. The user holds the camera in one hand with the lens facing down and scans the page. The camera senses the print and sends its image to the tactile converter.

b. The CRT lens

In order to read information from the microcomputer screen, another lens (CRT lens) replaces the regular OPTACON lens. The CRT lens is a long cylindrical device with an attachment socket at one end. The other end is a small round lens that is placed on the microcomputer screen (CRT).

c. The Tactile Display

The tactile display is located on the center front of the OPTACON. It is a raised tray with tiny holes through which pins protrude. The user places his/her index finger in the tray so that most of the area above the first knuckle is in contact with the display.

3. Input and Output Modes

a. Input Mode

To put information into the microcomputer when using the OPTACON as the access device, the student uses the regular keyboard of the Apple II Plus Microcomputer as described in Module One.

b. Output Mode

The OPTACON and CRT lens allow the user to read information directly from the monitor. The CRT lens is placed on the screen and subsequent OPTACON operation proceeds as it would when reading regular print. The print is read by the student using the tactile display.

III. Features and Operating Principles of Type-N-Talk speech synthesizer, with notes for Echo II users.

1. The Votrax Type-N-Talk is a speech synthesis device which provides output from the microcomputer in the form of spoken words. It is a small rectangular box with two control knobs on the front and three wires connected in the back. It uses electronically produced sounds to build spoken words from text displayed on the microcomputer's screen. A speech synthesized word often does not sound like the word as normally pronounced because the device has a limited number of phonemic sounds it can produce. A user of a speech synthesizer must become accustomed to the pronunciation of words produced by the device. A beginner may experience some frustration with interpreting the words read by the speech synthesizer and may have to repeat words and decrease the frequency (reading speed) if these features are present (available only on some devices). Practice with the device should increase the user's ability to understand the spoken output.

The Echo II consists of a card inserted in the back of the Apple and a disk of accompanying software. There is an external speaker which is the only externally visible component.

2. Controls of the Type-N-Talk

There are three operating controls on the Type-N-Talk that are available to the user. The front panel contains two control knobs which, from left to right, regulate the volume and the frequency (pitch) of the voice output respectively. The third control, the on/off switch, is located on the back of the device, to the right. When pressed in, the device is activated-and if properly connected responds with "system ready."

Echo II Note. The volume control for the Echo II is a screw-like plastic wheel which is on the board placed in a slot in the back of the Apple. Since it is necessary to open the case of the Apple II to adjust the volume, it should not be changed frequently. The speaker may be replaced with an earphone, if one with a plug of the appropriate size is available. Other parameters (e.g., Pitch, Rate, and Pronounciation of punctuation) are controlled by issuing CTRL-E commands from the keyboard (see reference manual of the Echo II for more details).

3. Input and Output Modes.

a. Input Mode

To put information into the microcomputer when using the Type-N-Talk or Echo II as the access device, the student uses the regular keyboard of the Apple II Plus Microcomputer as described in Module One. The Echo II will say the name of the key as it is pressed. The Type 'n Talk does not pronounce input until return is pressed or four seconds have elasped.

b. Output Mode

The Type-N-Talk and Echo II allow the student to receive information from the microcomputer by spoken words. These devices transform the information on the screen into voice output as described in the introduction.

IV. Features of Large Print as Access Technology for the Microcomputer.

1. In order to produce text in large print on the display screen of the Apple II Plus microcomputer, modifications must be made to the hardware or to the instructions (software) which control the microcomputer. Software modifications are accomplished by altering each program, purchased or written, individually through the inclusion of additional subroutines (lines of instruction code) which produce large print graphic characters. This method of generating large print allows a great deal of flexibility with regard to size, color and style of print generated. However, some commercially available programs cannot be modified in this way due to features of the software included to avoid illegal copying.

Hardware modifications can also provide large print output from the microcomputer. Closed ciruit television (CCTV) devices, which are used to enlarge many types of text, are available in models which can be attached to the microcomputer screen. These devices enlarge all material which appears on the screen, and are thus better than software modifications at providing general access in large print. However, such hardware modifications tend to be cumbersome in that they nearly exclude the use of the adapted screen by other users (e.g., OPTACON with CRT lens readers or regular print readers).

2. Input and Output Modes for Large Print

a. Input mode

Input into the microcomputer when using large print as a means of access is accomplished through the use of the regular keyboard of the Apple II Plus.

b. Output mode

Output is sent from the microcomputer to the display screen (CRT) and is either enlarged by software modifications or hardware modifications as described above.

PREINSTRUCTION CHECKLIST FOR TEACHERS
Module Two
Objective 2

1. Is the VersaBraille plugged in and ready for use with the battery charged as per instruction manual? Since the VersaBraille can operate off its own battery power, it should not be plugged into the power strip with the microcomputer and should always be turned off individually in addition to turning off the power strip.

2. Is the VersaBraille linked to the Apple II Plus by an input/output (I/O) CABLE (RS-232 cables as described in Appendix A)?

3. Is there a formatted cassette tape available whose first chapter contains the appropriate overlay for the Apple II Plus microcomputer (see Appendix B)?

4. Is the Serial interface card in slot #1 of the Apple II Plus? (If not, make necessary adjustments in text or change to slot #1.)

5. Is the student familiar with the braille keyboard and proficient in Grade 1 braille?

OBJECTIVE 2: Use a cassette braille device to access a microcomputer.

I. The Components of the VersaBraille

After the completion of Objective 1, the student should be familiar with the Tape Deck, Braille Display and Advance Bar, and the Braille Keys and Space Bar. In order to use the VersaBraille as a microcomputer terminal, it will be necessary to be familiar with additional components of the device.
*NOTE: VersaBraille keys described in this section are identified by being capitalized. FOR FURTHER DESCRIPTIONS SEE THE VERSABRAILLE USERS' MANUAL.

1. AUDIO SPEED and VOLUME Controls

In the lower left corner are two knobs that control the AUDIO SPEED (left control) and the VOLUME (right control). When the controls are positioned toward the user, both controls are on the lowest setting.

2. EJECT Button

The EJECT button is located on the upper left corner of the device. When the user presses the EJECT button once, current braille work and indexes are recorded, the tape is rewound, the tape deck opens, and the cassette tape can be removed. Holding the EJECT button for 6 seconds (panic eject) causes the tape deck to open immediately without recording on or rewinding the tape.

3. The AUDIO and BRAILLE SELECT Buttons

On the upper right corner of the VersaBraille, is a panel of nine buttons of different shapes and sizes. The upper two buttons (farthest from the user), are the AUDIO and BRAILLE SELECT buttons. The AUDIO SELECT button (left button) puts the device in the audio mode and allows the VersaBraille to be used as a regular cassette tape player/recorder. If the AUDIO SELECT button is used with a tape that has been used to record braille, the VersaBraille will stop without outputting the encoded braille.

4. The BRAILLE SELECT button (right button) puts the device in the braille mode and allows braille chapters to be created and accessed, and enables the device to serve as a braille microcomputer terminal.

5. The ADD NEW CHAPTER Button

The ADD NEW CHAPTER Button allows the user to write and name additional chapters to a previously formatted braille tape. It is located just below the AUDIO SELECT button.

6. The TEXT BACKUP Key

The TEXT BACKUP key is located in the bottom row of keys on the panel. It is on the left and is shorter and wider than the other keys. The student presses this key when s/he wishes to backup the text to the 20 characters just previous to the ones being displayed.

7. Text Access Keys

The four remaining keys on the bottom row with the text backup key are the text access keys. They are (from left to right) the CHAPTER key, the PAGE key, the PARAGRAPH key and the WORD key. These keys allow the user to locate specific parts of the tape or text.

8. The On/Off Switch

The on/off switch (a horizontally positioned rocker switch) is located on the back of the device. When the switch is pressed down on the left side, the device is on and responds with a characteristic beep.

II. Preparing the VersaBraille to Serve as a Terminal

1. Turn on the power by activating the rocker switch located in the back of the VersaBraille. When the power comes on the cassette door will open, a beep will sound, and the display will say, "READY."

2. Insert a formatted cassette tape in the door of the VersaBraille with the exposed tape side facing you.

3. Close the cassette door by pressing on both front corners.

4. Display will say "SELECT AUD, BRL, FOR" (select audio, braille or format). As we will be using the braille mode, press the BRAILLE SELECT key located in the upper right hand corner of the device. When the BRAILLE SELECT key is pressed, the machine will display the word "BUSY" and you will hear the tape turning.

5. When the tape stops, the title of the first chapter, which should be the overlay, will be displayed. Note that chapter titles cannot be used more than once.

6. Load the overlay into the VersaBraille's memory by pressing the ADVANCE BAR located on the VersaBraille. The display will read "BUSY" and the tape will again move.

7. When the tape stops, the display will read "OPEN NEW CHAPTER." NOTE: If you are using Model P2C of the

VersaBraille, the display will read "TERMINAL LOADED."

8. Press the ADD NEW CHAPTER key located in the upper right corner of the VersaBraille. The display will read "NAME."

9. Using the braille keyboard, type in the new chapter's name. Remember that you cannot use a chapter name more than once and the name cannot exceed ten characters in length. If you do, the device will beep to indicate the name is unacceptable.

10. Press the ADVANCE BAR. The display will show a (the "for" contraction) in the first position. This "cursor" ( ) will move as text is entered, thus continually indicating the end of the text and the position of the next blank space available for writing.

11. Activate the microcomputer as described in Module One, "Procedures for Running a Disk Program," steps 1-6, (Pages 13and 14).

12. As well as being an input device, the VersaBraille can also be used to receive information from the Apple II Plus. To prepare the microcomputer to send information to the VersaBraille, type PR#1 and press return. Finally, to prepare the microcomputer to look for input from the VersaBraille type IN#1 and press return.

13. You are now ready to put the device in remote mode in preparation for interacting with the microcomputer. Press dots, 1,2,3,5,(R) simultaneously with the space bar. This is called an "R Chord." Then press 1,2,3,5 (R) without the space bar. This is called an "R Chord R" command.

14. You are now ready to send and receive information.

III. User Notes

You need to know that:

1. Dots 4,5,6 (the control key in microcomputer braille) followed by Dots 1,3,4 represent the carriage return signal.

2. The display on the VersaBraille contains a maximum of only 20 characters. To read material displayed on the CRT via the VersaBraille display, you must press the ADVANCE BAR at the end of each 20 characters read. When you reach the end of a CRT display, the VersaBraille will beep to signal that the end has been reached. You may back up 20

characters at a time by pressing the TEXT BACK key on the VersaBraille.

3. Since the VersaBraille can operate on its own battery supply, it must always be turned off individually in addition to turning off the power strip (see Module 1).

4. If the panic eject key is pressed after the overlay has been loaded into the VersaBraille memory, the overlay will be erased from memory.

5. When using the VersaBraille Model P2C or a modified P1, the control key character is dot 4 instead of dots 4,5,6.

Preinstruction Checklist for Teachers
Module Two
Objective Three

1. Is the OPTACON fully charged?

2. Is the OPTACON plugged in and ready for use?

3. Is the CRT lens available?

4. Are the pin settings in CRT lens appropriate for the screen being used (see Appendix C for further instructions)?

5. Are all instructional materials ready for use?

6. Is the student a proficient OPTACON user?

OBJECTIVE THREE: Use the OPTACON to access a microcomputer.

I. Components of the OPTACON

In order to use the OPTACON as an access device, the student must be proficient in its normal operating procedures (as used to read ink print). Knowledge of all controls and tracking procedures are necessary for use of the OPTACON with a microcomputer. The only different component is the CRT lens which is attached to the retina. The lens used for regular print is not used for microcomputer access.

II. Instructions for Connecting and Operating the CRT Lens

INTRODUCTION

The CRT Lens Module F1A is an OPTACON accessory that may be attached to the retina of a Model RIC OPTACON to read some Cathode Ray Tube terminals. There are numerous variations in CRT's including those which are supposedly identical, which means that one's own OPTACON, the F1A CRT Lens Module, and the specific CRT in question must be evaluated together to determine if an effective reading system can be achieved.

Although the CRT Lens Module is designed to read characters 1/8 to 1/4 inch (3 to 6 mm) tall, there are significant variables which prevent TSI from consistently predicting which CRT's are readable. These include the brightness and contrast of the CRT display, the focus adjustment of the CRT tube curvature, extraneous light from the surrounding room, the refresh rate or the rate at which the CRT renews its image, and the ratio of character height to width.

FEATURES OF CRT LENS

The bayonet sleeve which accepts the OPTACON retina is on the back side of the CRT lens at the end closest to the user and furthest from the CRT screen during use. The front end of the F1A contains three small Teflon ball bearings which are positioned directly against the CRT screen during use. The features below are described in a sequence from back to front:

- Bayonet sleeve--Accepts the OPTACON retina which is inserted with a push/twist action.

- Zoom lens magnification adjustment--The zoom lens adjustment ring is at the back of the CRT lens barrel, just before the barrel makes a right angle turn to the bayonet sleeve. The ring has a larger diameter than the barrel. It slides forward and backward approximately 1/4 inch (6mm) with the forward position providing the greatest magnification. The ring can be locked into position from its "free-sliding" position by twisting it either clockwise or counter-clockwise relative to the barrel.

- Focus adjustment--Focus is adjusted by varying the length of the barrel. About 3/4 inch (19mm) forward from the zoom ring are two smaller knurled rings having the same diameter as the barrel. The forward ring is attached to the front half of the barrel. Turning it adjusts barrel length. The second ring (toward the back) is a lock ring. A flat side of the circumference of the barrel just forward of the two focus adjustment rings provides a tactile monitor of the number of turns made while adjusting barrel length. Eleven complete turns will adjust the barrel from minimum to maximum length.

- Light shield--The two-inch (51mm) diameter disk near the front of the CRT lens is designed to shield the CRT lens from extraneous light. In some situations, this shield may be unnecessary. On microcomputer systems where the text appears close to the edge of the screen, the shield may prevent the camera from accessing these characters when it strikes the frame of the screen. The shield can be unscrewed from the barrel and removed after separating the barrel in two by completely unscrewing the front section beyond its maximum extension.

- Teflon ball bearings--Provide smooth, low-friction movement of the CRT lens across both glass screens and protective dust covers.

INITIAL SET-UP PROCEDURES

Preliminaries: The sighted CRT user will generally prefer a very strong contrast between the characters and the background. This is usually not ideal for the OPTACON. The OPTACON generally works best when the CRT is very bright, in which case the contrast may be low. In other words, both the characters and the background are usually bright when CRT brightness and/or contrast settings will result in the appearance of retrace lines on the screen.

Preliminary to evaluating the CRT lens, one could ask a sighted assistant to adjust the CRT brightness and/or contrast controls (if present) to yield characters and background as bright as possible without significantly distorting character focus. Once set, these positions should be tactually marked (using tape or some other method) so they may be set by the OPTACON user.

Next, use the chart below to make an initial focus (barrel-length) adjustment. This adjustment will be based upon two factors: (1) The CRT lens are factory-adjusted at TSI to various internal lens settings, and (2) CRT's come with or without cover screens

LENS SETTING NO. 4 (Reads larger print)

CRT without cover screen: 9 complete turns from minimum.
CRT with cover screen: 9 complete turns from minimum.

LENS SETTING NO. 7 (Reads smaller print)

CRT without cover screen: 5 1/2 complete turns from minimum.
CRT with cover screen: One complete turn from minimum.

Remove the standard lens module from the OPTACON retina module and place it in the camera holder.

Adjust the zoom ring to minimum magnification by unlocking it, sliding it back toward the bayonet sleeve as far as possible, and relocking it.

Now, hold the CRT lens against the CRT screen. If your OPTACON is designed for left index finger reading, turn the lens until the bayonet sleeve (which accepts the retina) points left. (If your OPTACON is designed for right index finger reading, the bayonet sleeve should point right.) Holding the CRT lens this way, insert the retina module into the bayonet sleeve so that the camera cord emerges from the 12 o'clock position.

CRT Light Adjustments:

The following procedures are designed to determine whether the CRT emits enough light for the OPTACON to operate properly:

1. Both the CRT and the OPTACON should be on, with the OPTACON's normal/invert switch in the "invert" position.

2. Aim the CRT lens at a blank screen or blank portion of the display previously adjusted by a sighted assistant.

3. Turn the OPTACON's threshold counter-clockwise until the array "blooms." (All of the pins are vibrating.) Then back off by turning the threshold clockwise until the bloom just disappears.

4. Display a line of "L's" across the screen.

5. Leaving the OPTACON threshold at the setting in Step 3, scan the "L's." If the OPTACON responds, proceed with focus adjustments in the next section (NOTE: If the "L's" appear upside down, remove the retina module from the FIA, rotate is 180 degrees and replace it.) If the OPTACON does not respond, increase CRT contrast and repeat steps 2-5. If the OPTACON still does not react to print with any of the CRT contrast adjustments you have made, the lens you are using is probably not receiving enough light from your CRT's screen and probably will not work with your equipment. Try evaluating a lens with a different factory-adjusted lens setting (if you have one available), starting again with "Preliminaries."

FIA Focus Adjustments:

Ignore image size and leave magnification at a minimum with the zoom ring all the way back (toward you). Try to improve focus by using various barrel lengths, adjusting OPTACON threshold after each barrel length adjustment to determine if the image is becoming clearer. Try to find the barrel length adjustment which will provide the best average focus for characters appearing in both the corners and the center of the portion of the CRT screen that you will want to read.

Magnification Adjustment:

Using the zoom ring and the OPTACON's threshold adjustment, adjust magnification. When the magnification is adjusted to provide the correct image size, the focus may require readjustment, especially if your FlA has lens setting Number 4.

Improving CRT Light Adjustments:

Assuming that previous adjustments were properly made, the CRT lens should require no further focus or magnification adjustments. Next, you want to determine whether any additional adjustments to the CRT's intensity and/or contrast controls result in clearer images for the OPTACON.

NOTE: Not all CRT's have contrast or brightness controls. Some have a single brightness control which simultaneously adjusts intensity and contrast. Others have no external controls. If you cannot make the exact adjustment suggested, do the best you can within the limitations of your system.

You may notice a beat frequency or periodic pulsation in your OPTACON's array when reading the CRT screen. This is due to the fact that some CRT screens renew their images at a different rate than the OPTACON views them. The OPTACON camera's scan rate has been adjusted to the average refresh rate of the most popular CRT's. This may not be an exact synchronization with your CRT. This electronic incompatibility does not damage your OPTACON in any way.

Some CRT cover screens are quite flexible. As a result, you may discover that a character is in focus when you are applying very little pressure against the screen and out of focus when you apply enough pressure to bend the screen inward. Performance may be improved by removing the cover screen, if it is possible and safe to do so.

SUMMARY OF PROCEDURES FOR INITIAL CRT LENS ADJUSTMENT

1. CRT SHOULD BE VERY BRIGHT

* Contrast may be low.

2. TO SET UP

* Zoom = minimum.

* Retina points left for right-handed tracking.

* Camera cord at 12 o'clock.

* OPTACON = invert.

* Screen on - aim OPTACON at blank portion.

* Turn Threshold counter clockwise until array "blooms," back off until firing just disappears.

* Display line of "Ls" across screen.

* Scan L - if OPTACON responds proceed to focus adjustment; if OPTACON does not respond, increase contrast and repeat steps from screen adjustment through typing in L's; if still does not work, F1A probably not receiving enough light from CRT screen. Try another F1A at different adjustment setting.

Before attempting to improve the CRT's light adjustments, note the OPTACON's threshold setting and ask a sighted assistant to note the starting point CRT intensity and/or contrast settings. Now, without adjusting the lens, determine whether variations in the OPTACON threshold adjustment and the CRT intensity and contrast adjustments provide improved images. If not, return to the setting in use at the beginning of this section. Make note of these setting so that next time you use this CRT, you will have some way of quickly making the proper settings.

The above instructions assume that the CRT lens has brightness and contrast control (See NOTE, previous page).

3. FOCUS ADJUSTMENT

* Leave magnification at minimum.

* Try to improve focus by adjusting focus length one turn at a time, adjusting threshold after each

adjustment of focal length to see if image becoming clearer.

4. MAGNIFICATION ADJUSTMENT

* Adjusting magnification after previous routine may require additional focus adjustment.

* Best to start with magnification out a bit if you know you want larger letters.

5. IMPROVING CRT LIGHT ADJUSTMENT

* Note current threshold setting.

* Assuming previous adjustment proper for focal and magnification, see if additional adjustment to CRT's intensity or contrasts results in clearer image.

6. FIXING SETTINGS

* When setting is best, note threshold and focal and brightness positions and lock in magnification and focal length.

STEPS FOR ROUTINE USE OF THE CRT LENS

Once the initial setup for the CRT lens in use with your particular CRT screen has been established, the following sequence of steps will be required of the OPTACON CRT lens user each time the lens is used:

1. Set the contrast and brightness adjustments of the CRT screen to predetermined (marked) positions.

2. Set OPTACON to "Inverse" mode (using switch in rear of machine).

3. Remove the standard lens module from the OPTACON retina module and set it aside in a safe place.

4. Place the CRT lens against the screen with the bayonet sleeve pointing left, for left index finger reading (pointing right for right index finger reading) and insert the retina module into the bayonet sleeve so that the camera cord emerges from the 12 o'clock position.

5. Check to see that the zoom ring adjustment is at the predetermined setting, and adjust CRT lens brightness and contrast controls to pre-established settings if available.

6. Turn on OPTACON and adjust threshold and intensity for best reading image.

III. Tracking

The user of OPTACON as an access device for the microcomputer should use the tracking procedures described for normal print. Using the OPTACON and CRT lens to access a screen in the vertical position (as it is for sighted users) can be cumbersome and tiring. Therfore, for prolonged use of the OPTACON as an access device, transfer of the screen to a horizontal position can make tracking easier. Tracking guides which attach directly to the CRT screen and hold the CRT lens in position are available (contact Telesensory Systems, Inc. for more information).

Checklist for Teachers
Module Two
Objective Four

1. Is the Votrax Type-N-Talk plugged into its power supply?

2. Is the power supply plugged into the power strip?

3. Is the speaker plugged into the speaker jack (on the back of the device)?

4. Is the Votrax connected to a serial card in a slot #1 in the back of the Apple? (If the Votrax is plugged into another slot make the necessary adjustments in the text.)

OBJECTIVE FOUR: Use the Votrax Type-N-Talk to access a microcomputer

I. Components of the Type-N-Talk

As described in Objective One, there are three controls for the Type-N-Talk. The on/off switch is on the back of the device to the right. The front panel contains two control knobs which regulate the volume and frequency.

II. Procedures for Activating the Votrax Type-N-Talk

A. Push in the on/off switch to the on position - the device should respond "system ready."

B. Boot the diskette (as described in Module One)

C. Type PR# and the slot number to which the device is attached and press return.

III. Additional User Notes

A. Adjusting frequency and volume controls can make the speech more understandable.

B. The PR# command must be entered each time the reset button is pressed.

C. Cable configurations are found in Appendix D.

D. Graphics in programs are ignored by the speech synthesizer.

E. More sophisticated speech synthesizers are available at higher cost. These include additional features which, for example, allow the user to locate the position of the cursor on the screen at any time and review previously spoken material.

IV. For Echo II Users

The Echo II has both a hardware and software component, both must be in place before speech output is provided. The hardware component is a card which must be installed in a slot (1 to 7) in the back of the Apple computer-- once installed this component need not be readjusted by the user again. The software component consists of a program which must be loaded into the computer each time it is turned on. To install the component, the disk which comes with the Echo II (or a copy) must be placed in the disk drive and a special program run by typing:

BRUN TEXTALKER.RAM (This command is used if your Apple II Plus has a 16K Ram card in Slot #0 or if you are using an Apple IIe)

or

```
BRUN TEXTALKER.BLIND
```

Following this, other programs can be loaded and run as described in Module One (see Echo II manual for further details on installation and functions).

PERFORMANCE TEST

MODULE TWO/OBJECTIVE ONE

INSTRUCTIONS/SCORING CRITERIA

I. Locating the major components of the VersaBraille.

The teacher should read the question to the student, read the name of each component listed one at a time and mark the test protocol as the student responds. Mark a "+" below the number corresponding to each component listed at the right if the student correctly locates it by pointing or touching it. Mark a "-" if the student does not independently locate the component, and physically guide his/her hands to the component.

II. Correct Responses - Mark a "+" on the protocol if the student answers with correct response.

1. Braille Keys and Space Bar.

2. Braille Display.

III. Locating the major components of the OPTACON.

See instructions listed in Question I.

IV. Correct Responses - Mark a "+" on the protocol if the student answers with the correct response.

1. The Apple II Plus Microcomputer keyboard.

2. The OPTACON Camera, CRT lens, and tactile display.

V. Locating the major components of the Type-N-Talk speech synthesizer

See instructions listed in Question I.

VI. Correct Responses - Mark a "+" on the protocol if the student answers with the correct response.

1. The microcomputer keyboard.

2. The spoken word produced by the Type-N-Talk.

II. Correct Responses - Mark a "+" on the protocol if the student answers with the correct response.

1. Software or hardware.
2. The microcomputer keyboard.
3. Enlarged print on the screen.

TEST ITEMS

I. I am going to read a list of major components of the VersaBraille that you are expected to know. Then I will read the name of one component at time and I want you to locate and show me the component I have named.

1. Tape Deck.
2. Braille Display and Advance Bar.
3. Braille Keys Control and Space Bar.

II. I am going to read a statement which you are to complete.

1. The input mode for the microcomputer from the VersaBraille is ...

2. The output mode from the microcomputer to the VersaBraille is ...

III. I am going to read a list of major components of the OPTACON that you are expected to know. Then I will read the name of one component at a time and I want you to locate and show me the component I have named.

1. The Camera.

2. The CRT lens.

3. The tactile display.

IV. I am going to read a statement which you are to complete.

1. The input mode for the microcomputer when the OPTACON is the access device is ...

2. The output mode when the OPTACON is the access device is ...

V. I am going to read a list of major components of the Type-N-Talk that you are expected to know. Then I will read the name of one component at a time and I want you to locate and show me the component I have named.

1. Volume Control.
2. Frequency Control.
3. Off/On Switch.

VI. I am going to read a statement which you are to complete.

1. The input mode for the microcomputer when the Type-N-Talk is the access device is ...
2. The output mode for the microcomputer when the Type-N-Talk is the access device is ...

VII. I am going to read a statement which you are to complete.

1. In order to produce enlarged print on the Apple II Plus, modification can be made to the (BLANK) or (BLANK).

2. The input mode for the Apple II Plus when large print is the access technology is ...

3. The output mode for the microcomputer when large print is the access technology is ...

PERFORMANCE TEST

MODULE TWO/OBJECTIVE TWO

INSTRUCTIONS/SCORING CRITERIA

I. Locating the major components of the VersaBraille

The teacher should read the question to the student, read the name of each component listed one at a time and mark the test protocol as the student responds. Mark a "+" below the number corresponding to each component listed at the right if the student correctly locates it by pointing or touching it. Mark a "-" if the student does not independently locate the component, and then physically guide his/her hands to the component.

1. Variable AUDIO SPEED and VOLUME Controls.
2. EJECT Button.
3. AUDIO/BRAILLE SELECT Button.
4. ADD NEW CHAPTER Button.
5. TEXT BACKUP Key.
6. TEXT ACCESS Keys.
7. OFF/ON Switch.
8. Braille Display
9. Braille Keyboard

II. The teacher should give the student the formatted cassette tape and read the instructions under "Test Item." The teacher should remind the student to verbalize the step before performing it. Place a number in front of each step to record the order in which the student names them. If the step is in the correct sequence, the student should be asked to perform the step, but the teacher should stop the student from performing the step named if it is out of order. Incorrect answers should be recorded. The first time the student names a step out of order, the teacher should prompt for the correct order. If the second answer is wrong on the same step, the remaining steps are scored "-".

1. Turn on the VersaBraille.
2. Insert the formatted cassette tape.
3. Close the cassette door.
4. Select Braille.
5. Find the title of the first chapter.
6. Load the overlay.
7. Read "Open new chapter."
8. Press "Add New Chapter" button.
9. Type in new chapter name.
10. Press advance bar.
11. Activate microcomputer by turning on the power

strip.

12. Type PR#1 then IN#1.
13. Press R CHORD then R.

TEST ITEMS

I. I am going to read a list of major components of the VersaBraille that you are expected to know. Then I will read the name of one component at a time and I want you to LOCATE and SHOW me the component I have named.

II. Now we are going to prepare the VersaBraille to serve as a terminal. Using the VersaBraille, please TELL me and SHOW me the thirteen steps you must follow to corrctly prepare the VersaBraille to be a microcomputer terminal. Be sure to use the correct order.

PERFORMANCE TEST

MODULE TWO/OBJECTIVE THREE

INSTRUCTIONS/SCORING CRITERIA

I. Locating major components of the OPTACON.

The teacher should read the question to the student, read the name of each component listed one at a time and mark the test protocol as the student responds. Mark a "+" below the number correspoding to each component listed at the right if the student correctly locates it by pointing or touching it. Mark a "-" if the student does not independently locate the component, and physically guide his/her hands to the component.

1. Bayonet sleeve.
2. Zoom lens magnification adjustment.
3. Focal length adjustment.
4. Light shield.

II. The teacher should have the student sit at the microcomputer with the OPTACON positioned on the left side of the computer. The teacher should remind the student to verbalize the step before performing it. Place a number in front of each step to record the order in which the student names them. If the step is in the correct sequence, the student should be asked to perform the step, but the teacher should stop the student from performing the step named if it is out of order. Incorrect answers should be recorded. The first time the student names a step out of order, the teacher should prompt for the correct order. If the second answer is wrong on the same step, the remaining steps are scored "-".

1. Set the contrast and brightness adjustments of the CRT screen to predetermined (marked) positions.

2. Set OPTACON to "Inverse" mode (using switch in rear of machine.

3. Remove the standard lens module from the OPTACON retina module and set it aside in a safe place.

4. Properly insert the retina module into the bayonet sleeve so that the camera cord emerges from the 12 o'clock position.

5. Check to see that the zoom ring adjustment is at the predetermined setting. Properly adjust if necessary.

6. Turn on the OPTACON and adjust threshold and intensity for best reading image.

TEST ITEMS

I. I am going to read a list of major components of the OPTACON that you are expected to know. Then I will read the name of one component at a time and I want you to LOCATE and SHOW me the component I have named.

II. Now we are going to prepare the OPTACON to serve as an access device. Using the OPTACON, please TELL me and SHOW me the six steps you must follow to correctly prepare the OPTACON. Be sure the use the correct order.

PERFORMANCE TEST

MODULE TWO/OBJECTIVE FOUR

INSTRUCTIONS/SCORING CRITERIA

The student should be seated at the microcomputer which has been interfaced with the Type-N-Talk. The teacher should remind the student to verbalize the step before performing it. Place a number in front of each step to record the order in which the student names it. If the step is in the correct sequence, the student should be asked to perform the step, but the teacher should stop the student from performing the step named if it is out of order. Incorrect answers should be recorded. The first time the student names a step out of order, the teacher should prompt for the correct order. If the second answer is wrong on the same step, the remaining steps are scored "-".

1. Turn on the Type-N-Talk.
2. Boot the diskette.
3. Type PR# and the appropriate slot number and press return.

NOTE for ECHO II Users

The following are the correct steps to prepare the ECHO II to serve as an access device. Use the same INSTRUCTIONS/SCORING CRITERIA as for the Type-N-Talk.

1. Boot the diskette
2. Type in one of the following commands depending on the hardware being used.
    a. BRUN TEXTALKER.BLIND
    b. BRUN TEXTALKER.RAM

TEST ITEM

Now we are going to prepare the Type-N-Talk to serve as an access device. Using the Type-N-Talk and the microcomputer, please TELL me and SHOW me the three steps you must follow to correctly prepare the Type-N-Talk. Be sure to use the correct order.

MODULE THREE
Introduction to Basic Programming

This module introduces the computer language BASIC (Beginners All-Purpose Symbolic Instructional Code), through an interactive program on the Apple II Plus microcomputer. In this module the student will be introduced to a few elementary BASIC commands and will learn to analyze simple programs.

Knowledge of BASIC can be a key to understanding microcomputers and an important advanced skill for using them. BASIC has several advantages as a student's first computer language. First, it is a simple, yet powerful, language for doing standard calculations - much like a very powerful calculator. Second, it is a rich language for efficiently designing a wide range of advanced applications involving both the manipulation of numbers and the manipulation of words. One reason BASIC is so popular is its conversational nature. A BASIC program is very similar to other types of written instructions. BASIC makes communicating with a computer natural, simple, and straightforward. Learning BASIC is like learning to speak a foreign language, but somewhat easier. There are fewer than 50 commands in BASIC. Although the student will not learn all 50 commands, s/he will learn the most frequently used statements and commands which will enable him/her to analyze written programs.

INTRODUCTION

After completion of Module Two, the student should be proficient in the use of one or more pieces of access technology for the Apple II Plus Microcomputer. It is necessary for the student to be capable of independently using the microcomputer before this module is attempted. The teacher may wish to have the student practice with available programs before beginning this module. The module test for Module Two represents a minimum competency and additional practice is often desirable before proceeding.

As was noted previously, Module Three is an interactive program. The student will use the microcomputer, access technology, and Module Three program (provided on the program disk accompanying these modules) to learn about BASIC. Module Three is divided into three objectives with a test at the end of each. In the CATALOG, the objectives are listed as Objective 1, Objective 2, and Objective 3, sequentially. The student should complete the activities of the module and then proceed to the test. As before, the test may be taken as many times as necessary to reach 100% criteria. As you will notice, the user can go to the objective test at anytime during the run of the objective by using Control C. It will be necessary for you to instruct the student to tell you when they are taking the test and report their score since you will not be giving the test as in the previous modules, and the student's score is not recorded by the microcomputer! To acquaint yourself with the content and presentation of Module Three, run the objectives and take the tests prior to giving them to a student.

GOAL

To introduce the student to programming in the BASIC language.

Module Objectives

1. To introduce the student to the following concepts:

   A. A computer language
   B. A line number
   C. A variable
   D. An arithmetic expression
   E. Punctuation

2. To introduce the student to the following BASIC statements and commands:

   A. Print
   B. Remark
   C. Let
   D. End
   E. List
   F. Run

3. To introduce the student to the following additional BASIC statements:

   A. Goto
   B. If...Then
   C. Input

Start-Up Procedure for Module Three Disk

The procedure for loading the Module Three program is the same as that for loading any other program. This procedure is described in detail in Module One. Below is a brief summary to serve as a guide for your use of Module Three.

1. Insert the Disk in the Primary Drive.

2. Turn on the microcomputer.

3. Choose the desired program from the CATALOG.

4. Type RUN, and the exact name of the program.

5. Be sure to REMOVE THE DISK before deactivating.

6. Remember to record the student's score each time they take the test for the Objectives of Module Three--GOOD LUCK.

APPENDIX A

CABLE CONFIGURATIONS
and
CONFIGURATION CONTROL PARAMETERS
for
INTERFACING THE APPLE II AND THE VERSABRAILLE P2B

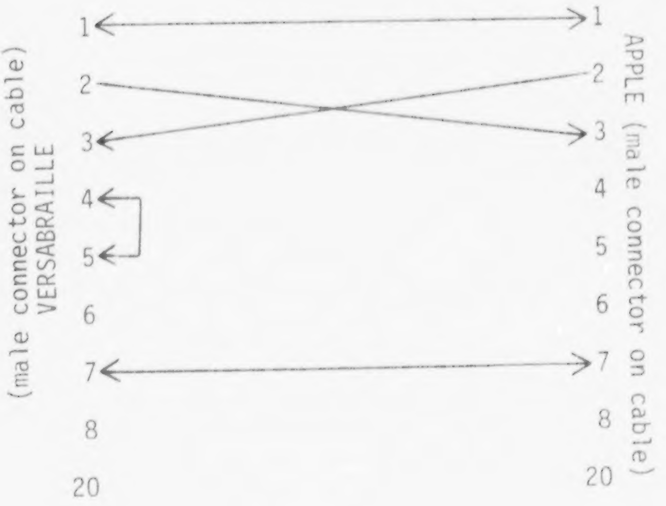
INTERFACING THE APPLE II PLUS WITH THE VERSABRAILLE

The Versabraille Model P2 conforms to the Electronic Industries Association's standards for the RS-232-C interface. In order to connect a Versabraille to the Apple II Plus, one must install a RS-232-C interface card in one of the slots inside the computer. Several companies manufacture RS-232-C interface cards for the Apple II and each has different capabilities and requirements. Five different cards were tested with the Versabraille. They were the Apple II Serial Interface Card (A2L0008), the Apple II Communication Interface Card (A2L0003X), the Apple II Super Serial Card, and the California Computer Systems Model 7710 Asynchronous Serial Interface Card versions A and D. The interface dip switch settings, the configurationcontrol parameters for the Versabraille and the cable requirements to join the two devices are given on the following pages. Please read the notes concerning advantages and limitations of each interface card. The Apple II Serial Interface (A2l0008) and the Apple II Super Serial Card were preferred since they did not connect either the keyboard or the monitor of the computer when the Versabraille was initialized.

The authors realize that there are many possible combinations of parameters and cables. The settings and cables listed were selected in an attempt to simplify and standardize testing in the research laboratory.

CABLE CONFIGURATIONS FOR THE APPLE AND THE VERSABRAILLE

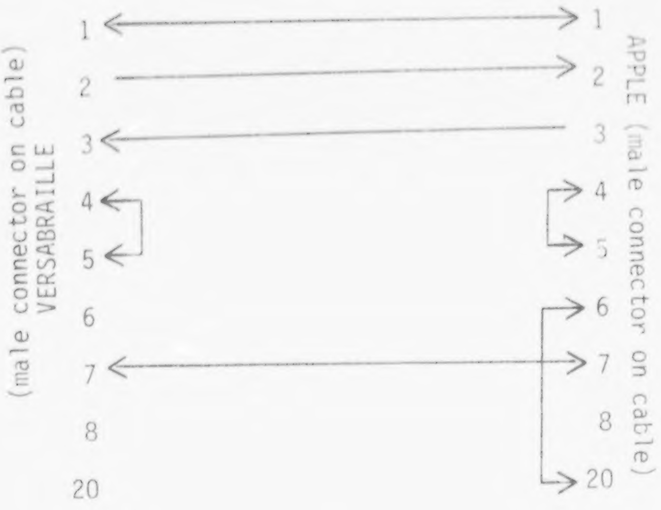
APPLE COMMUNICATION CARD


(male connector on cable)
VERSABRAILLE
APPLE (male connector on cable)
1
2
3
4
5
6
7
8
20
1
2
3
4
5
6
7
8
20

Duplex=Full

Computer's keyboard is disconnected when VersaBraille keyboard is activated.

CALIFORNIA COMPUTER SYSTEMS 7710 SERIAL CARD (Versions A or D)


(male connector on cable)
VERSABRAILLE
APPLE (male connector on cable)
1
2
3
4
5
6
7
8
20
1
2
3
4
5
6
7
8
20

Duplex=Full

Version A - Computer's CRT and keyboard are disconnected when VersaBraille is activated.

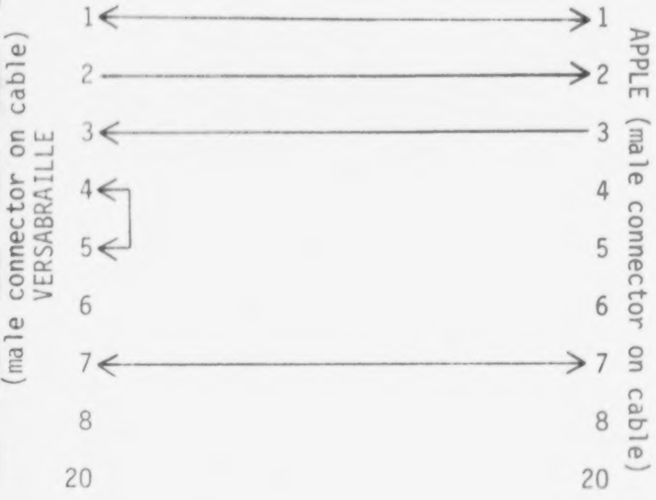
Version D - Computer's keyboard is disconnected when VersaBraille's keyboard is activated.

Dip Switch settings

off on off off

CABLE CONFIGURATIONS FOR THE APPLE AND THE VERSABRAILLE

APPLE SERIAL CARD


VERSABRAILLE
(male connector on cable)
APPLE (male connector on cable)
1
2
3
4
5
6
7
8
20
1
2
3
4
5
6
7
8
20

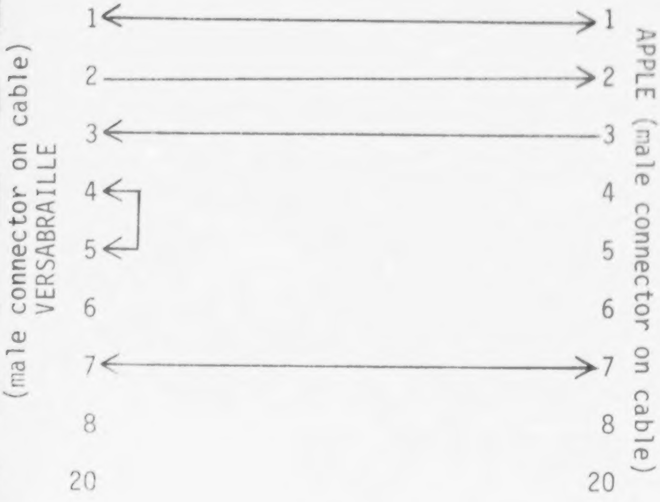
Duplex=Half

Preferred because it supplies dual output (both CRT and braill display) and allows dual input (both braille keyboard and computer's keyboard).

Dip Switch Settings

on off on on on on on

SUPER SERIAL CARD


VERSABRAILLE
(male connector on cable)
APPLE (male connector on cable)
1
2
3
4
5
6
7
8
20
1
2
3
4
5
6
7
8
20

Duplex=Full

Preferred because it supplies dual output (both CRT and braille display) and allows dual input (both braille keyboard and computer's keyboard).

Dip Switch Settings

SW1 - on off off on off on off
SW2 - on off on on off off off

Jumper Block pointing toward terminal

CONFIGURATION CONTROL PARAMETERS (CCPs) FOR THE VERSABRAILLE

	Apple Serial	Super Serial Card CCS 7710(A or D) Apple Communication
Baud Rate	300	300
Data Length	8	8
Parity	None	None
Stop Bits	2	2
Translation	C	C
Line Length	80	80
Page Length	0	0
**CI	SP	
Carriage Return Delay	0	0
End of Transmission	eot	eot
Duplex	half	full
Handshake	dtr	dtr
*Received Data	no	no
End-of-Line Character In	yes	yes
End-of-Line Character Out	cr	cr
Acknowledge	no	no
**Device Control Character Input	no	no
**Clear to Send	no	no
Data Signal Ready	no	no
Carrier Detect	no	no

*Only on overlays for Models P2A and P2B

**Only on overlays for Model P2C

APPENDIX B

CABLE CONFIGURATIONS
and
SWITCH SETTINGS
for
INTERFACING THE VOTRAX TYPE-N-TALK
with
THE APPLE II PLUS

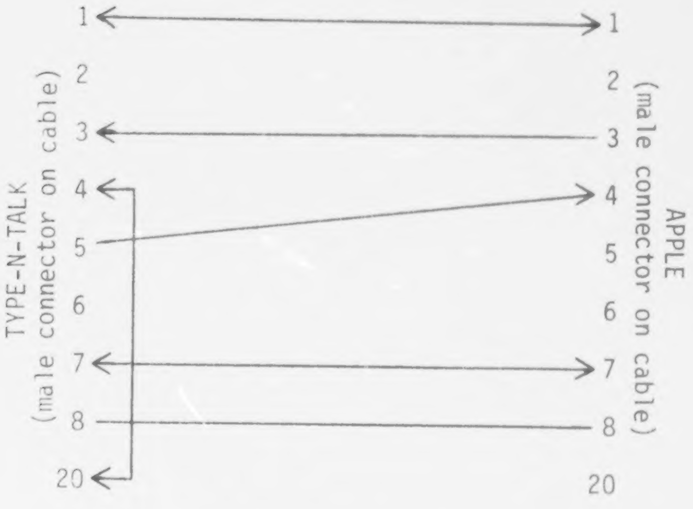
INTERFACING THE APPLE II PLUS WITH THE VOTRAX TYPE-N-TALK

The Votrax Type-N-Talk conforms to the Electronics Industries Association's standards for the RS-232-C interface. In order to connect the Type-N-Talk to the Apple II Plus, one must install a RS-232-C interface card in one of the slots inside the computer. Several companies manufacture RS-232-C interface cards for the Apple II and each has different capabilities and requirements. Five different cards were tested with the Type-N-Talk. They were the Apple II Serial Interface Card (A2L0008), the Apple II Communication Interface Card (A2L0003X), the Apple II Super Serial Card, and the California Computer Systems Model 7710 Asynchronous Serial Interface Card versions A and D. The interface card dip switch settings, the dip switch settings for the Type-N-Talk and the cable requirements to join the two devices are given on the following pages. Please read the notes concerning advantages and limitations of each interface card. The Apple II Serial Interface Card (A2L0008) and the Apple II Communications Interface Card (A2L0003X) were found to be unsuitable since they lacked the ability to halt transmission upon receiving a busy signal from the Type-N-Talk (handshaking). The Apple II Super Serial Card and the California Computer Systems Model 7710 Asynchronous Serial Interface card VERSION D were preferred because they did not disconnect the Apple II monitor when the Type-N-Talk was initialized.

The authors realize that there are many possible combinations of parameters and cables. The settings and cables listed were selected in an attempt to simplify and standardize testing in the research laboratory.

CABLE CONFIGURATIONS FOR THE APPLE AND THE VOTRAX TYPE-N-TALK

CALIFORNIA COMPUTER SYSTEMS 7710 SERIAL CARD (Versions A or D)


TYPE-N-TALK
(male connector on cable)
1
2
3
4
5
6
7
8
20
APPLE
(male connector on cable)
1
2
3
4
5
6
7
8
20

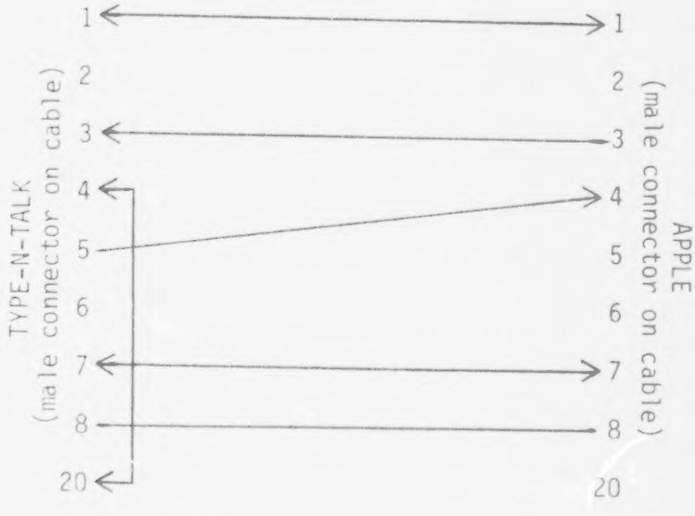
Version A - Hardware handshaking prevents loss of output during lengthy transmissions. Computer's CRT will be disconnected when the TYPE-N-TALK is initialized.

Version D - Hardware handshaking presents loss of output during lengthy transmission. Computer's CRT will not be disconnected when the TYPE-N-TALK is initialized.

Dip Switch Settings

off on off off

SUPER SERIAL CARD


TYPE-N-TALK
(male connector on cable)
1
2
3
4
5
6
7
8
20
APPLE
(male connector on cable)
1
2
3
4
5
6
7
8
20

Hardware handshaking prevents loss of output during lengthy transmissions.

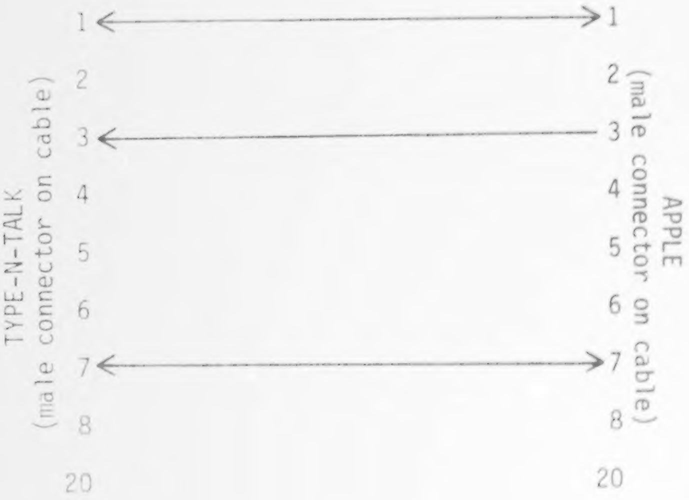
Dip Switch Settings

on off off on on on on

on on on on on on off

CABLE CONFIGURATIONS FOR THE APPLE AND THE VOTRAX TYPE-N-TALK

APPLE SERIAL CARD


TYPE-N-TALK
(male connector on cable)
1
2
3
4
5
6
7
8
20
APPLE
(male connector on cable)
1
2
3
4
5
6
7
8
20

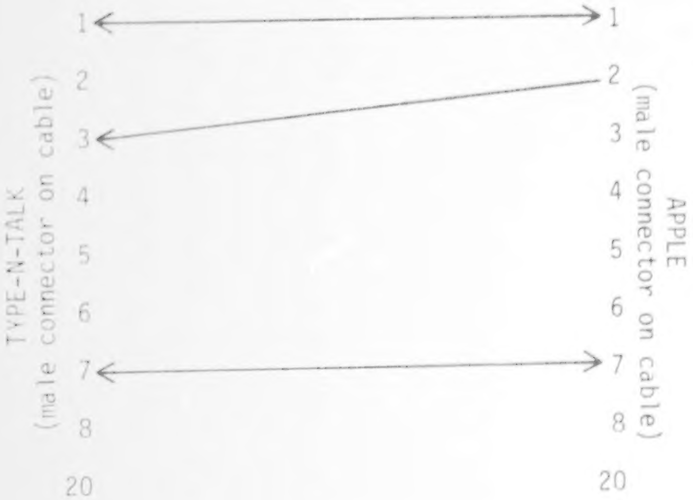
Lengthy transmissions will cause some output to be skipped when synthesizer falls behind. (No handshaking)

Requires cable to speaker

Dip Switch Settings

on off on on on on on

APPLE COMMUNICATION CARD


TYPE-N-TALK
(male connector on cable)
1
2
3
4
5
6
7
8
20
APPLE
(male connector on cable)
1
2
3
4
5
6
7
8
20

Lengthy transmissions will cause some output to be skipped when synthesizer falls behind. (No handshaking)

Requires cable to speaker

APPENDIX C

PIN SETTINGS FOR THE F1A OPTACON LENS

APPENDIX C

Recommended F1A Pin Settings
FOR CRT COMPUTER SYSTEMS

Manufacturer	Terminal Model #	F1A #	F2B
Apple II		questionable	
Altair	CT2		yes
Ann Arbor	203162K4080D	9	
Commodore	CBM2001, PET2001	7	best
Computer Automation	Syra Info System		yes
Computer Consoles Inc.		4	yes
Computer Optics	77,78	7	
Control Data Corp	3800	7 & 9	
Courier		7	
Data Media	Elite 1520-1522	7	
Delta Data	5000,5200,5300	4	
Digital Equip Corp (DEC)	VT05, 50, 52, 100	7 & 9	
Elbit (CDC computers)	DS 1920X		
GTE Info System	Video Master, Ultronic	4	
Harris		7	
Hazeltine	1500	7	
Heath	H 19	7 & 4	
Hewlett-Packard (HP)	2645, 3000, 9835, 9845, 911	7	
"	2621, 2640, 2640 B	4	
Honeywell	6/36, VIP 7760	4	
ICL (England)	7561, 7700 Info Proc Sys	4	
Incoterm	1020, 1025, 2020, 0660 X	7	
"	K2501	9	
Intel	Maestro	7	
IBM	3275, 3277 Mod I	4	
"	3275, 3277 Mod II, 2915	7	
"	3278 Mods 1-5, 5110	9 & 12	
"	MS 100 (from Japan)	7 & 9	
ITT	Data Speed 40	7	
Jacquard	J100 & J105	4	
Lear Sigler Inc.	ADM 1, 2, 3	7	
Memorex	1307	4	
Newbury Labs, Inc	7002		
Perkin-Elmer	550		
Plessey	90/15, 90/11B		
Qantel	CRT 2	4	
Radio Shack	TRS 80	7	
Raytheon	PTS 1000	7	
Systems Integrators Inc.	Video Terminal ET 960	4	yes
Tektronic	4013, 4051, 40	not readable	
Teleray	3300	not readable	
Teletype	MID 40		
Terak	8510 A	not readable	
Texas Instruments	Video Terminal 911	4	
Univac	UTS 400	4	
Wang	2200 VS, 2236	7	
Westinghouse	1600	7	

APPENDIX C
(continued)

Recommended F1A Pin Settings
FOR CRT WORD PROCESSING SYSTEMS

Manufacturer	Terminal Model #	F1A #	F2B
AES	Plus	7	
CPT	8000	regular lens	
Daconics	Visual Type	4 & 7	
IBM	System 6	9 & 7	
Jacquard	J100 & J105	4	
Lanier	No Problem, Text Editor I-III D, DD	7 & 9	
Lexitron	900 series	9 & 12	
"	1000 series	9	
3M	Word Processing System	4	
Motorola	9000	7	
NBI	System 3000 . . . . regular lens	4	yes
Olinetti	ET 201, 221 TES 401, 501	not readable	
"	CRT screen	same as NBI	
Rothenberg	Information System	not verified, appears readable	
Redaction	CRT system	not verified	
Vydec	1100, 1200, 1400	9	
Wang	10, 20, 30	7	
Word Plex (Denison)		7 & 9	
Xerox	850 one line	1	yes
"	850 full page	7 & 9	yes

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APPENDIX D

BRAILLE-EDIT STUDENT INSTRUCTIONAL MODULE

BRAILLE-EDIT STUDENT INSTRUCTIONAL MODULE

Introduction to Braille-Edit

What is word processing?

Word processing is a way to use a microcomputer to help you prepare written work. A word processing program may be used to write something on floppy disk. While it is on the disk, you may make any corrections you wish. Also, you can use special commands to tell the computer what you would like the paper to look like when it is printed. All of this is done before the paper is ever printed.

Is there a word processor for braille readers?

Yes. In this module, you will learn to use one of the braille word processors called Braille-Edit.

How can Braille-Edit help me?

You can use Braille-Edit to write papers for school or to write letters. It is very easy to correct mistakes with Braille-Edit. You don't have to worry about rubbing out mistakes since mistakes are corrected while your paper is still on the disk. You can print your work in either braille or print. So, you can write a letter to a print reading friend in braille and then use Braille-Edit to translate it into regular print. You will learn how to do this later.

What do I need to know before I
start learning to use Braille-Edit?

You must know several things. First, you need to know the different parts of the microcomputer system and what they do. Second, you must know how to power up the system and boot the disk. Third, you need to know how to run a program and shut down the microcomputer when you are finished. Fourth, you must know how to use one access device, such as Echo II, VersaBraille, or the Optacon.

You learned to do these things in the other modules. If you passed the tests for Modules 1 and 2, then you are ready to start with Braille-Edit.

Equipment

What equipment will I need in
order to use Braille-Edit?

You will need an Apple II microcomputer, a Braille-Edit program disk, an access device, and a printer. You will also need a blank floppy disk if you have 2 disk drives.

How do I input information?

Input means to put something into the microcomputer. You will be inputting words. There are several ways to input information into the microcomputer.

The first way is to use the regular Apple keyboard with Echo II output. You would type words on the computer keyboard in the same way you would on a typewriter. Also, you would listen to what you were writing using Echo II. Then Braille-Edit could translate your work into Grade II braille before it is printed. This module will teach you to use the regular keyboard with the Echo II.

Another way is to use certain keys on the computer keyboard as a brailler. The letters z, x, c, n, m, and comma on the bottom row stand for the six keys of a brailler. You can use these keys to input braille into the microcomputer the same way you would use a braillewriter. You would use Echo II to listen to what you are writing.

If you know how to use the Optacon and CRT lens, you could read what you write directly from the monitor. You might want to use the Optacon and the Echo II together. To input information, you would use the regular keyboard or the keyboard as a brailler.

The next way is to use the VersaBraille connected to the microcomputer. This would let you write and read in braille as you input words.

Another way to input information is to use the Cranmer Modified Perkins Brailler. This would be similar to using the VersaBraille. You will learn later how to use the Cranmer Modified Perkins Brailler as a printing device.

Background Information on Braille-Edit

There are some things you should know before you actually start with Braille-Edit. This will make the directions easier to understand later.

Utility Menu. A menu is a list of things a computer will do. It actually makes the software program easier to use. To make the computer do something, you just type one letter that stands for the command you want. The Utility Menu of Braille-Edit lets you do things like print something you have written or quit when you are finished. You will learn to use some commands in the Utility Menu in the next section.

Data Entry Mode. In order to input information, you must be in the Data Entry Mode. In the Data Entry Mode you can write something and make changes by using special commands. When you are finished writing, you can save your work by giving one of the commands. You will learn to get into the Data Entry Mode and to save your work in the next section.

Control Commands. You use control commands to tell the computer to do certain things. To use a control command, you hold down on the control key and push a certain letter at the same time. Control commands are used when you are in the Data Entry Mode. For example, the control Q command tells the computer you want to quit and to save your work. You will learn to use this command in the next section.

Editor Menu. After you save your work, the Editor Menu will appear. The Editor Menu lets you do things like getting a list of things you have written or going to the Utility Menu.

Configurations. A configuration tells the computer some information about how you want to use Braille-Edit. For example, it will tell the computer if you want to use Echo II or VersaBraille. Also, it tells certain things about how you want your work printed. Your teacher will program your configuration for you at the beginning. Your configuration will be your first name. Later, you will learn how to use your configuration.

Files. The computer stores your work in files. It is like storing things in a metal file cabinet. Ask your teacher to show you the file cabinet in the classroom. Every time you write something different with Braille-Edit, you will store it in a file. A file is also called a "chapter" and you will give each chapter a name.

Getting Started with Braille-Edit

Using the Regular Keyboard with Echo II

This section will teach you to input information using the regular keyboard. It will be much like typing on a typewriter. The position of the keys on the computer is the same as on the typewriter. There are also some extra keys on the computer which you will learn to use. When you use the regular keyboard to input information you must spell out each word. You cannot use braille contractions. Braille-Edit will translate your work into Grade 2 braille for you. You will use Echo II as an access device.

In this lesson you will go through all the basic steps in writing something with Braille-Edit. First, you will write a short paragraph and save it. Second, you will translate your work into Grade 2 braille using Braille-Edit. Third, you will print your paragraph. Later, you will learn to make corrections. Ready to start? Great!

What are the steps in writing
something with Braille-Edit?

1. LOADING AND BOOTING THE DISKS

Put the Braille-Edit program disk in Drive 1 and your blank disk in Drive 2. Remember to shut the doors. Then, boot the disks by turning on the power strip. You will hear the disk drives whirring.

2. ENTERING THE CONFIGURATION

When the disk drives stop whirring, you will hear a beep. This beep means that you should enter your configuration. Do this by typing in your first name and pressing the return key. You will hear the disk drives whirring again. After this, Echo II will start speaking everything that appears on the screen.

3. GETTING TO THE DATA ENTRY MODE

The first thing you will hear is "Utility Menu. Enter command." Braille-Edit always gives you the Utility Menu first. You want to get into the Data Entry Mode. To do this, you will type 'E' by itself. This is one command on the Utility Menu which stands for "Editor." Notice that Echo II will always do this to help you. Type "E" now if you haven't already. You will hear the disk drives whirring again. Then you will hear "Chapter." That means you are in the Data Entry Mode.

4. NAMING YOUR FILE

When you hear Echo II say "Chapter," you should give your

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file a chapter name. Think of a name for your chapter that will be easy for you to remember. Your chapter name can have one to ten letters. You can use numbers in your chapter name, but the first character must be a letter. Do not use punctuation in the chapter name. Type in your chapter name. Listen to the letters that you are typing to make sure you do not make any mistakes. Then press "return." Echo II will say "On drive 2? No is the default." Since you want this chapter to be put on the disk in drive 2, type the letter "Y" for "yes." Press return. Then Echo II will say "New Chapter OK? Yes is the default." If your chapter name is OK, just press return. If you made a mistake in the chapter name, type "n" for "no" and the computer will let you enter the chapter name again.

5. WRITING A PARAGRAPH

Then you will hear "Data Entry." That means that you can start writing. If you want Echo II to say each letter as you write, press control-E. Remember, when you give the control-E command you must hold down on the control key and hit the E at the same time. Now you need to press the "caps lock" key once. That will let you use the shift key to write capital letters. Now write a short paragraph and listen for Echo II to say each letter as you type. If you make some mistakes, do not worry about them. You will learn to correct them later.

6. SAVING YOUR FILE

After you are finished, you will need to ask the computer to save your file. You do this by using a special control character. The control-Q command tells the computer you want to quit and to save your work on the blank disk. Remember, when you give a control command you must hold down on the control key and press the Q at the same time. Do this now to save your file.

You will hear the disk drives whirring. This means that the computer is storing your file on the blank disk in Drive 2. When it is finished, you will hear "Editor Menu. Enter command." At this point, you have written and saved your work.

CONGRATULATIONS!!! You have just finished the first step in word processing with Braille-Edit. Before we go on, let's review the main steps so far:

1. Load and boot the disks.
2. Enter your configuration.
3. Go from the Utility Menu to the Data Entry Mode by typing the letter "E."
4. Give your file a chapter name of one to ten letters or numbers.
5. Write your paragraph.
6. Save your file by entering the control-Q command.

How do I use Braille-Edit to translate my file into Grade 2 braille?

You are now ready to translate your file into Grade 2 braille. Braille-Edit will do this for you.

1. GETTING TO THE UTILITY MENU

You just saved your file and Echo II responded "Editor Menu. Enter command." The Grade 2 Translator is in the Utility Menu. You need to move from the Editor Menu to the Utility Menu. To do this, type "U" for "Utility Menu." You will hear the disk drives whirring and Echo II will say "Utility Menu. Enter command."

2. ENTERING THE GRADE 2 TRANSLATOR COMMAND

You are now in the Utility Menu. Type the letter "G" for "Grade 2 Translator."

3. ENTERING THE SOURCE CHAPTER

When the disk drives stop whirring, Echo II will say "Source Chapter." This is the name of the file you just wrote and now want to translate. Type in your file name. Echo II will say "On Drive 2? No is the default." Type 'Y' for "Yes" since your file is saved on drive 2. Press return.

4. ENTERING THE TARGET CHAPTER

Echo II will say "Target Chapter." This is what you want your translated file to be called. Type in a name for your translated file. You might want to put "B" in front of the source chapter name to stand for "Braille." For example, if your source chapter is called "PRACTICE," you might call your target chapter "BPRACTICE." That will be easy for you to remember. After you have typed in the new name, press return. Echo II will say "On drive 2? No is the default." Type "Y" for "yes" and press return.

Then Echo II will say "Enter another pair. Source Chapter." You can ignore this for now by pressing return. Echo II will say "Starting to translate."

5. COMPLETING THE TRANSLATION

You will hear the disk drives whirring. This means that the Braille-Edit is translating your original file into Grade 2 braille. Echo II will say "Chapter --------- done. Done" when it is finished. Then it will say "Utility Menu. Enter command."

You now have a file in Grade 2 braille that is ready to be printed. GOOD WORK!!! You are doing a great job! Let's review how to translate a file:

1. Get to the Utility Menu.
2. Type "G" for "Grade II Translator."
3. Type in the name of the "Source Chapter."
4. Type in the name of the "Target Chapter."
5. Braille-Edit will translate your file.

How do I print my file?

1. HOOKING UP THE PRINTER

Now you want to print your file. You will need your teacher's help at first to hook up the printer. Later, you will probably be able to do this on your own.

2. ENTERING THE "PRINT CHAPTERS" COMMAND

You must be in the Utility Menu to print your file. That is where you are now. Now type the letter "P" for "Print Chapters." Press return. You will hear the disk drives whirring. Then Echo II will say "Print Chapters. Chapter."

3. ENTERING THE CHAPTER NAME

After you hear "Chapter," type in the name of your file that was translated into Grade 2 braille. Press return. Echo II will say "On drive 2? No is the default." Type "Y" for "yes" and press return. Then, Echo II will say "Chapter." Ignore this for now by pressing the return key. Now Echo II will say "Print whole chapter? Yes is the default." You want the whole chapter printed, so just press return. Then you will hear "Default parameters? Yes is the default." The default parameters are entered with your configuration. Since you do not want to change them, just press return.

4. PRINTING THE CHAPTER

Now you will hear the disk drives whirring and the printer will start printing your file. You will be able to hear the printer working. When the printing is finished, Echo II will say "Utility Menu. Enter command."

5. QUITTING

You are ready to quit now. Type "Q" for "Quit." Echo II will say "Ready." Remove the disks and turn off the computer.

Now you can read your file that was just printed. GREAT WORK!!! This is your first paragraph written with Braille-Edit. Did you make some mistakes in your paragraph? Don't worry about them. In the next section, you will learn to correct mistakes. Before we go on, let's review how to print a file.

1. Hook up your braille printer.
2. Type "P" for "Print Chapters" in the Utility Menu.
3. When Echo II says "Chapter," type in the name of your Grade 2 file. Press return.
4. When Echo II says "Chapter" again, press return.
5. When Echo II says "Print Whole Chapter," press return.
6. When Echo II says "Default Parameters," press return.
7. Your file will now be printed.

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8. Echo II will say "Utility Menu" when it is finished printing.

9. Press "Q" to "Quit."

10. Remove the disks and turn off the computer.

Beginning Editing Procedures

What do I do if I make an error or
if I want to add something to my chapter?

In the last section, you learned the basic steps in creating a chapter, translating it into Grade 2 braille, and printing the chapter. When you read your work after it was printed, you may have noticed that there were some mistakes. That is no problem. We all make mistakes. One of the most important steps in writing something is editing your work. That just means correcting and revising your chapter. Braille-Edit lets you edit your work very easily. That way you can make all of your revisions before you print your chapter. This section will teach you some of the basic editing procedures using Braille-Edit.

I. FINDING YOUR CHAPTER

To find a chapter you wrote, you use many of the same steps you learned before. Here is a review of those steps. Only step #4 is different.

1. Load and boot the disks.

2. Enter your configuration.

3. When Echo II says "Utility Menu. Enter command," type "E" for "Editor."

4. Echo II will then say "Chapter." Now you should type in the name of the chapter you want to edit. It must be exactly the same as before. Echo II will say "On Drive 2? No is the default." Type "Y" for "yes." When the disk drives stop whirring, Echo II will say "Data Entry." Now you have found the chapter you are going to edit.

If you make a mistake in typing in the name of your chapter, Echo II will say "New Chapter OK? Yes is the default." That means that Braille-Edit thinks you want to start a NEW chapter. If this happens, type "N" for "no" and then you can enter your chapter name correctly.

2. REVIEWING YOUR CHAPTER

The first step in revising your work is to review what you have written. There are two ways you can do this. You can have Echo II read your file word-by-word or spell it letter-by-letter.

When you first start reviewing your chapter, you will probably want Echo II to read everything first in words. To do this, press control-T. Remember, you must hold down the control key and hit T at the same time. When you press control-T, Echo II will say about 8 words and then will beep. Press control-T again and it will say the next several words. Keep doing this until you get to the end of the chapter. You might just want to hold down the control and T keys without releasing the keys each time. Then Echo II will keep reading until it comes to the end of your chapter. When it reaches the end, Echo II will say "End of page."

When you hear Echo II reading word-by-word, it will be easier for you to tell if you want to change the meaning of your work. While you listen to your chapter, ask yourself: "Is that what I wanted to say?" You might want to add a word to describe something better. You might want to take out a sentence that doesn't fit very well. Or you might even want to add several sentences to make the meaning clearer. These are the types of revisions you will want to make first. You will learn to make changes like this soon.

After you listen to your chapter read word-by-word, you may want to have Echo II spell everything letter-by-letter. That way you can check for spelling and punctuation mistakes. First, you will need to get back to the beginning of your chapter. To do this, press control-Z and then hit the space bar. Now the cursor will be on the beginning of the first word of your chapter.

The easiest way to have Echo II spell each letter is to use the right and left arrows. On the Apple IIe they are located on the bottom row. The left arrow is the second key to the right of the space bar. The right arrow is the third key to the right of the space bar. When you press down either key, the cursor will move one space to the right or left and Echo II will say that letter or character.

Notice that if you start reviewing your chapter by hitting the right arrow key, Echo II will say the SECOND letter. To hear the first letter, you will need to hit the left arrow key. Then start moving right until you find a mistake that you need to correct or until you get to the end of your chapter. If you need to back up, just press the left arrow key. When you hold down either key Echo II will keep spelling until you release it. As you will hear, Echo II tells you what letters are capitalized by saying, "Cap." It will also tell you where the spaces and punctuation marks are located.

3. CORRECTING SIMPLE MISTAKES

You are ready to begin correcting your work. A few mistakes will be very easy to correct with Braille-Edit. Sometimes you just need to replace an incorrect letter with the correct letter. You do this by typing the correct letter over the incorrect letter. For example, let's say you wrote "sime" instead of "some." All you need to do is replace the "i" using the right and left arrow keys. Remember, when Echo II says a letter, the cursor is directly on that letter. When the cursor is on the "i," simply type "o" and the word will be corrected. To be sure, review the spelling of the word using the arrow keys.

You CANNOT use this procedure if you need to take away or add a letter to correct a mistake. For example, to take away an "o" in "soome" or to add an "o" in "sme," you would need to use special commands. You will learn to do this next.

4. DELETING INFORMATION

Now you are ready to start correcting your other mistakes. You will do this by deleting and inserting information. In this section you will learn to delete information. Deleting information just means to take something away that you do not want in your file.

The control-D command lets you delete information. The simplest way to use this command is to delete one letter at a time. For example, if you spelled "Look" with an extra "o" (Loook), you would want to delete one of the o's. To delete one letter, move the cursor to that letter using the right and left arrow keys. When the cursor is on the letter you want to delete, press control-D and then hit the space bar. After you hit the space bar the letter will be deleted. Now you will want to check the spelling of the word using the arrow keys just to be sure that you deleted the right letter.

There will be times that you will want to delete several letters or words. You could delete them one at a time, as you learned above, but there is a faster way. Let's say that you wrote this sentence: Yesterday, I went to went to Nashville. Of course, the second "went to" should not be there, so you want to delete it. To delete more than one letter, put the cursor on the first letter of the word or words you want to take away. Then, press control-D and type in the number of characters you want to delete. Now hit the space bar and the information will be deleted.

In the example above, you would want to delete 8 characters: 4 letters in "went," 1 space after "went," 2 letters in "to," and 1 space after "to." So put the cursor on the "w" in "went," press control-D, type in 8, hit the space bar, and the extra "went to" will be deleted. Again, you will want to review your work to make sure you deleted the right words and spaces.

5. INSERTING INFORMATION

In this section, you will learn to insert information. Inserting information means to add something to your work that was not there before. You might want to insert letters, words, or even sentences.

The control-I command lets you insert information. After you insert the information, you must hit control-N. For example, let's say that you wrote this sentence: It is time for lnch. Since you wrote "lnch" instead of "lunch," you will want to insert a "u. To insert this letter, move the cursor to the "n" in "lnch." Braille-Edit will start inserting at the point where the cursor is placed. When the cursor is on the "n," press control-I, type the letter "u," then press control-N. After you press control-N, Braille-Edit will go ahead and insert the "u." Now you can check the spelling of "lunch" to be sure that you inserted the correct letter in the right place.

You can use the control-I command followed by the control-N command to insert as much information as you want. For example, let's say that you wanted to write "It is time for our class to go to lunch" instead of "It is time for lunch." In this case, you will want to add "our class to go to" between "for" and "lunch." To do this, first move the cursor to the "l" in lunch. That is where you want to start inserting. Press control-I, type in "our class to go to" and space, then press control-N. Now check your sentence to be sure it is correct. This same procedure can be used to insert sentences or even paragraphs.

6. SAVING THE CORRECTED CHAPTER

After you have corrected all of the mistakes, you will want to save your edited chapter. Use the control-Q command as you did before when you wanted to quit. Braille-Edit will save your edited chapter in place of the original chapter.

How can I move around in my chapter faster?

In the last section you learned some basic ways to move around in a chapter. There are a few more commands that will help you.

ADVANCE AND BACK COMMANDS

Sometimes you will want to go directly to the end of a chapter. To do this, press control-A (for Advance) and then hit the space bar. Then you will be at the end of the chapter. You will use this command when you want to add more to the chapter without reviewing the part that has already been written. This is much faster than using the right arrow key or control-T.

As mentioned before, you can use the back command to get to the beginning of a chapter. Just press control-Z and hit the space bar. This is the fastest way to get to the beginning of a file you are going to review.

You can also use the control-A and control-Z commands to quickly move through part of your chapter. To move a certain number of character spaces, just enter the number of characters you wish to move after pressing control-A or control-Z and before hitting the space bar. For example, let's say you want to move ahead 200 spaces. Press control-A, type in 200, and then hit the space bar. The cursor will then move ahead 200 character spaces. You could move back 200 spaces by pressing control-Z, typing in 200, and hitting the space bar.

SCREEN FORWARD AND SCREEN BACK COMMANDS

If you have a very large file, you might find the screen forward and screen back commands helpful in reviewing a chapter. The screen will hold 720 characters. So when you use these commands you will be moving about 720 characters at a time.

Control-F is the screen forward command. When you press control-F it will move you ahead 720 characters. You can continue pressing control-F until you reach the end of your chapter. You will hear a beep when you get to the last screen of text. Control-B is the screen back command. This will move you back through your chapter 720 characters at a time until you reach the first screen.

LOCATE COMMAND

The locate command will help you find a specific word or a few words in your chapter. To use the locate command, press control-L and type in up to 20 characters that you would like to find. Then press control-N and Braille-Edit will start to search for the word or words you requested. When found, the cursor will be placed at the beginning of the word or words and Echo II will say the cursor location. For example, let's say you wanted to locate the words "to Nashville" in your chapter. Press control-L, type in "to Nashville," and then press control-N. If the characters you requested cannot be found, you will hear a beep and the cursor will be placed at the beginning of the page. This would happen, for instance, if you misspelled the word or words you wanted Braille-Edit to locate.

This command can be very helpful in correcting mistakes.

Let's say that you spelled "recieve" for "receive" incorrectly throughout your chapter. Press control-L, type in "recieve," and press control-N. Braille-Edit will then find the first place where this word appeared and you can correct it. Then just press control-L control-N and it will find the next place where "recieve" appeared. You do not need to re-enter the word if you are looking for the same one.

When you are using the locate command, it is very important to spell the words just as they appear in your chapter. If you have trouble locating words you request, it may be that you are not spelling them the same way.

Advanced Procedures with Braille-Edit

Word Processing Features

Braille-Edit allows you to use some word processing features to help format your work. The format of your chapter just means how it is arranged on the paper when it is printed. First, you will learn to indent paragraphs. Then, you will learn to use three word processing features. These use special commands for centering something, spacing, and numbering pages.

INDENTING PARAGRAPHS

When you use a braille writer, you show that a new paragraph is starting by indenting two spaces. It is much the same with Braille-Edit. As you know, when you use Braille-Edit you do not need to hit the carriage return as you do on a typewriter. Braille-Edit takes care of that for you. But when you want to start a new paragraph, you will use the carriage return. To indent, hit the carriage return and space two times. Then when your chapter is printed, Braille-Edit will indent two spaces which shows a new paragraph.

CENTERING, SPACING, AND NUMBERING PAGES

Braille-Edit uses simple commands to help you format your work. These word processing commands use two dollar signs followed by letters and numbers. If you want something centered, type $$c and then the word or words you want to center. Make sure there are spaces before and after the $$c. Also, you need to hit the carriage return after you type in the words you want centered. For example, if you are writing a paper called "My Vacation," you would want to center the title at the top of the page. So you would space and then type "$$c My Vacation" followed by a carriage return. If you want to center something in the middle of a story, make sure to hit the carriage return before the $$c also.

If you want Braille-Edit to double-space between the lines in your chapter, enter the command "$$L2" at the very beginning of your file. If you want single-spacing, you don't need to do anything. Braille-Edit will use single spaces between lines unless you tell it to use double spaces.

If you write a long paper, you should number the pages. To number the pages in braille format, put the command "$$nb" at the beginning of your chapter. Braille-Edit will then automatically number the pages in the lower right-hand corner of each page.

PAGES

As you know, Braille-Edit stores your work in chapters. Each chapter also contains pages. You will probably only use one page most of the time. However, if you are writing a long paper over, you will need to change pages. Each page in a chapter holds 4,096 characters. This is about 4 large pages of braille. When you use all 4,096 characters on a page, Braille-Edit will beep and will not let you type anything else. To change pages, type control-P and hit the space bar. The disk drives will start whirring. When they stop you will be on a new page.

If you are using the Grade 2 Translator, you can only put 3,800 characters on a page. If you type in more than 3,800 characters without changing to a new page, the Grade 2 Translator will not work correctly. To find out how many characters are on a page, use the control-W command. The W stands for where. Echo II will tell you the cursor position, buffer size, and the page number. You will want to listen to the buffer size. When it is getting around 3,800 characters, it will be time to change to a new page by entering the control-P command, typing in the number of the next page, and hitting the space bar.

Sometimes you might put more than 3,800 characters on a page. If you are using the Grade 2 Translator, you will need to go back and cut the page at some point around 3,800. To do this, move back through your file using the left arrow key or control-Z command. Stop occasionally and use the control-W command to determine where you are. Now you will want to listen to the cursor position. When you get to around 3,800 without going over, put the cursor at the beginning of a sentence or paragraph. Then use the cut page command. This is a control-C followed by a control-P. When the disk drives stop whirring, the page will be cut where you had the cursor.

When you are working on a big paper, you might need to move from page to page in order to edit your work. To do this, just enter control-P and the page number you want, then hit the space bar. You will be on the page you requested when the disk drives stop whirring.

More Information on Braille-Edit

You now know the basic steps and commands to do word processing with Braille-Edit. There are many more commands and things that Braille-Edit can do. These will be helpful to you as you get better and better at word processing. To learn more about how Braille-Edit can help you, ask your teacher for the Documentation Disks. These disks can be used with Echo II. They contain all of the commands used in Braille-Edit.

APPENDIX E

STATEMENT OF POLICY AND CRITERIA FOR SOFTWARE EVALUATION

5/10/83

Statement of Policy and Criteria for Software Evaluation

Project on Multi-Media Access to Microcomputers for Visually Impaired Students

Young, M., Williams, S., Fink, C., & Ashcroft, S.

POLICY

Educational microcomputers software can be of very diverse content and quality. Both content and quality must be evaluated before the software can be recommended for general educational use by students who are not handicapped. This project has accepted and adopted the MicroSift Evaluation form and procedures for educational software evaluation. Any equally good criteria would serve the intended purpose.

For visually impaired students to benefit from educational microcomputer software, special access technology may often be required. The use of such technology places additional restrictions on software from which educational benefits can be realized.

Following is a list of evaluation criteria which must be considered when access technology for visually impaired students is in use. These criteria are based on the assumption that the educational content and quality of the software has been or is simultaneously being evaluated. Thus, these criteria are suggested as additions to existing criteria and procedures for software evaluation.

These criteria are intended for use by teachers of visually impaired youth who themselves have little or no computer experience. They represent general criteria which cover issues for students throughout the wide range of visual impairments. Not all criteria will be appropriate for determining accessibility for any particular student; and, thus, no one criterion is sufficient for rejecting the use of a piece of software. Rather, each criterion should be considered for its appropriateness when a specific combination of student and access technology has been determined. In fact, sometimes the interests of different levels of visual impairments will conflict. For example, a version of software that has been modified for low vision students through the use of large print graphic characters may be inaccessible through braille or the Optacon, while the original unmodified version was accessible through these devices. In short, the criteria presented clarify issues of software evaluation for the range of visually impaired students and their appropriateness for individual students is left to the teacher's discretion

Criterion 1

Is the software copy-protected so that program instructions cannot be modified to include addition or deletion of program lines and the output of the program cannot be directed to a serial port for peripheral equipment?

Reason: As a protection against unauthorized copying of the program, some software contains its own disk operating system (DOS) which does not permit the use of serial interfaces, editing and listing of the source code, or modification to large print.

Criterion 2

Does the software present material in column or other ususual format and to what extent is the format of material essential to understanding and benefitting from the program?

Reason: Braille machines and voice synthesis devices only produce material line-by-line. If two or more columns of material are presented or unusual formats are used (e.g., screen "masks" presented which use PRINT@ statements to insert responses), the material becomes much more difficult to read and understand through braille and voice devices.

Criterion 3

Does the software contain pictures, nonstandard characters, nonprint symbols, or other graphics, and to what extent are these graphics essential to understanding and benefitting from the program?

Reason: Most braille and voice synthesis devices cannot convey graphic information to the user (AFB has a full-page braille display under development). While large print graphic characters are helpful for some low vision students, they may not be able to be displayed on other access devices.

Criterion 4

Does the software use commands that can only be entered from the keyboard of the microcomputer on which the program is running?

Reason: Input to programs using these commands cannot be made from access devices such as cassette braille machines.

Criterion 5

Does the program lack provisions for users to save their work (if appropriate) prior to completing the program and restart the program at the point it was interrupted?

Reason: Access devices slow the output and extend the duration of programs, thus highlighting the need to be able to interact with the program in parts.

Criterion 6

Does the program use time as a constraint (e.g., quicker answers receive higher points)? Can this timing be controlled by the user?

Reason: The slower the display of material by access technology may produce an immediate disadvantage for the visually impaired user.

Criterion 7

Does material scroll off the screen beyond the control of the user?

Reason: Longer examination may often be required by OPTACON or large-print readers.

Criterion 8

Is sound,used to reinforce material (hardware permitting), absent from the program?

Reason: Sound cues can often facilitate access to the program by visually impaired students.

Criterion 9

Are there user support materials that would have to be provided in braille, audio, or large-print form, along with the software for the effective independent use of the program? Further, are there copyright constraints against adapting the program or documentation?

Reason: Software without user supporting materials (in a readable medium) is often useless.

Criterion 10

Is the program modified so that normally sighted users cannot independently use the program along with the required access technology?

Reason: The addition of access technology may make the use of the program more complex (e.g., graphics helpful to sighted users might be eliminated for voice or braille output).

Criterion 11

Does the program use Inverse video to highlight key concepts?

Reason: The OPTACON with CRT lens has difficulty reading material that switches between Normal and Inverse.

Criterion 12

Does the program present unusual color/background combinations?

Reason: Some color graphics nearly blend with the background when presented on monochrome monitors, thus providing insufficient contrast for low vision and OPTACON readers.

List of Changes from Draft One

Last paragraph of policy statement added.

Criterion

1. Wording changed to include deletion of lines and Yes=Bad format.
R1. Clarified for modification to large print.

2. Same
R2. Added screen masks.

3. Same
R3. Modified to reflect AFB full-page display and clarify large print issue.

4. Clarified to machine language code
R4. Same

5. Added "(if appropriate)" and changed to Yes=Bad format.
R5. Same

6. Added Question about User's Control.
R6. Same

7. Clarified to specify "scrolling" and changed to Yes=Bad format
R7. Same

8. Added "hardware permitting" and changed to Yes=Bad format.
R8. Same

9. Added question on copyright protection.
9R. Same

Old 10. Deleted as concerning hardware rather than software issues.

New 10. From old #11. Changed to Yes=Bad format.
R10. Example added

11 & 12. Are new criteria.

APPENDIX F

WORKSHOPS

WORKSHOP OBJECTIVES

MAIN: Present access and microcomputer technology and how it is useful to both teachers and visually handicapped students.

SUBOBJECTIVES:

1. Provide an overview of vocational and avocational microcomputer-related opportunities for visually impaired students.
2. Develop an appreciation for microcomputer technology.
3. Provide an overview of the educational applications of microcomputers.
4. Emphasize that the teacher's role can be one of facilitator and not a computer expert.
5. Give details of access technology for visually impaired persons.
6. Provide an opportunity for participants to view educational software programs.
7. Provide "hands-on" experience with access and microcomputer technology and educational software.

SAMPLE
WORKSHOP SCHEDULE

TIME	TOPIC	PRESENTER
8:30	Loop Programs/Greetings	
8:35	Workshop Objectives and Schedule	
8:45	Pretest	
9:05	Micros in School and Society: Implications for the Special Education of Visually Impaired Persons	
9:15	Computer Technology (vocabulary)	
10:00	Break (10 minutes)	
10:15	Educational Applications/Software	
11:00	Access Technology a. Cassette Braille b. Voice Output c. Optacon d. Large Print	
12:15	Posttest	
12:30	Lunch	
	Hands-On experience	
1:30	Group 1	
2:30	Group 2	
3:30	Group 3	

Hands-On descriptions

Station 1--Apple IIe
- VersaBraille
- Optacon
- Large Print

Station 2--Apple II Plus
- Type-N-Talk
- Total Talk
- Large Print
- Digitized Speech

Station 3--
- Video Tape
- Books/Magazines/Equipment Brochures

I. Loop Program/greetings
   - A. Objectives:
     1. Display Equipment
     2. Provide opportunity for viewing of demo programs
   - B. Equipment
     1. Apple II Plus
     2. Loop program software
     3. Books, magazines, and equipment brochures
   - C. Presenter - all staff
   - D. Activities
     1. Pass out: survey summary, glossary, schedule, and workshop objectives
     2. Final check on equipment

MICROS IN SCHOOL AND SOCIETY:' APPLICATIONS FOR VISUALLY IMPAIRED STUDENTS

A. Objective - To provide an overview of the microcomputer revolution in school and society and thereby provide a framework and supporting reasons for learning more about the technology and its application to the special education of visually impaired persons.

B. Topics Outline

1. Background -- Today's technology

2. Micros will be around . . . in society and schools . . . as careers . . . in everything else, too.

3. Micros Being Used in Special Education

    a. Survey results illustrate growing use.

    b. Taber. Lindsey. -- highlight other special education applications.

    c. Technology in other devices --

        1. Mobility Aids -- Sonic Guide, Laser Cane, and Mowat Sensor.
        2. Talking instruments -- (calculators, typewriters, etc.)
        3. Braillex, Braillochord, Braillink, Rose Reader, AFB's full page, CMPB project, DELTA reader, ViewScan, Talking Optacon.
        4. Library of Congress' interest in cassette braille.

4. The Strengths and Limitations of Micros in Education . . .

    1. Papers -- " quotations "
    2. Tucker.

5. Definition of Access Technology and the Continuum of Options in Access Technology

6. Software Evaluation with Special Applications for Visually Impaired Students

COMPUTER TERMINOLOGY

A. Objectives

Main: Estabilsh a common vocabulary to facilitate the presentation of microcomputer technology and the access devices for visually impaired persons.
Subobjectives:

1. Identify commonly used components of microcomputer systems and explain the relationship of these components to each other.

2. Define acronyms and technical expressions frequently used in the discussion of microcomputers.

B. Equipment

1. Apple Computer
   a. Printed circuit board
   b. Integrated circuit

2. Input/Output Devices
   a. Monitor
   b. Keyboard
   c. Disk drives/Tape recorder
   d. Diskette/cassette tape
   e. Printer
   f. Access devices for visually impaired

C. Activities

1. Introduction

2. Hardware components

3. Software concepts

4. Questions

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INTRODUCTION TO COMPUTER TERMINOLOGY

I. Introduction

A. Description of computer by child

"What happens when you load a program? Well, what happens...this is the mouth (pointing to a disk drive) and the computer eats the program off the disk. Then it goes through here, (pointing to the disk cable) like a straw, to the computer's stomach. Here's its face (the TV monitor) like a big eye, and you can look in and see what's in the stomach...Then when you say RUN, the computer's got the energy to run 'cause it ate the program. If you don't load the program, it can't run 'cause there's no energy to...You know what else computers eat? Potato chips. I hear there's lots of chips in these things.--Tony, age 8." Creative Computing, April 1982

B. Specialized vocabulary creates mystique.

Sp. Ed. has its own vocabulary (LD, MR, EMR, VI). Break this down by using analogies to everyday items of technology that everyone is familiar with.

II. Hardware

A. Computer, analogy - calculator

1. CRT

(Cathode Ray Tube, also called video, screen, VDT). Computers standard method of communicating with user. Performs the same function as the display of a calculator.

2. Keyboard.

User's standard method of communicating with computer. The keyboard performs the same function as the keys of a calculator; however, there are many more keys for letters and special symbols and the keys are arranged in a fashion similar to a typewriter.

3. Computer

Analogy - brain (Remove lid and point out components as they are discussed.)

a. Basic components are chips

Not potato chips, but wafers of silicon called IC's (short for integrated circuit) upon which are etched an electronic circuit. IC's are mounted in DIP's (Dual In-Line Packages) although the name IC is often used to refer to both the chip and the container. These electronic components are then attached to a fiberglass board (called a PC or printed circuit board) where they can exchange information via traces of metal on the board.

(1). ROM (Read-Only Memory)

An IC which holds information that was permanently encoded at the factory. This information does not disappear when the computer is turned off. One important ROM is the microprocessor.an IC which understands and executes machine language programs. Information can only be read from ROM. it can t be written on ROM. PROM - Programmable ROM. EPROM - Erasable Programmable ROM.

(2). RAM (Random-Acess Memory)
This acronym is used to refer to the main computer storage area where information can be written and read. One unit of RAM (approximately equivalent to one character such as a letter or number) is called a byte. It is made up of a group of electronic switches called a bit. A group of 1024 bytes is called 1 K of memory.

b. Power supply
c. Speaker
d. Slots
Smaller boards (sometimes called cards) can be plugged into these slots. Additional boards can be used to expand and diversify the functions of the computer. Ex. extra memory. more languages. control of equipment such as answering telephones.

B. Input/Output (abbreviated I/O)
The user must have ways of getting information into the computer (input) and ways of getting information out (output). If we use the analogy of the calculator. the buttons are input devices and the display is the output device. In the case of the tape recorder. the microphone is the input device. the speaker is the output device. and the tape itself is a storage medium which we can write on and play back or read.

1. Monitor
2. Keyboard
3. Disk drive and disk
4. Tape player and cassette
5. Printer
6. Modems convert digital impulses from a computer into tones which can be transmitted over the telephone.
7. Terminals with modem for remote computer.
8. Terminals utilizing braille input and braille and speech output.

III. Software

A. Introduction
Two things are stored in the memory of the computer - Programs. or instructions detailing the tasks to be performed. and Data. the information which is to be processed. Ex. To perform the task of filing letters. the method and movements would be comparable to the program. and the letters would be comparable to the data. Without these instructions the computer could do

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nothing. They must be extremely detailed (Ex. filing - pick up letter, stand up, turn right, walk four steps to cabinent, open drawer). The more complex the task, the more   instructions and the more memory required. The more data (letters) to be processed the more memory (bigger file cabinet) required.

B. Instructions - Programs

1. Permanent instructions - ROM

Some instructions that tell what the computer is to do when it is turned on stay permanently in memory. Ex. start drive. Single purpose computers such as calculators, microwaves, and arcade games have permanent instructions.

2. Temporary instructions - RAM

The computer also has memory available for temporary instruction. If stereo had only one record it would be boring. This memory can be loaded with instructions for a task such as accounting, word processing, or Space Invaders and when that task is finished, new instructions can be loaded. These instructions disappear when the power is turned off.

C. Computer Languages

1. Different types

Just as one can say hello in French, English or Spanish one can tell the computer to print in BASIC, COBOL, or PASCAL. Different languages were designed for use by different machines (Applesoft Basic) or by different people (beginners - BASIC, teachers - PILOT, businessmen - COBOL)

2. Must be translated

Languages exists for the convenience of the user. The computer speaks only one language and other languages must be translated by a translator program or compiler.

D. Software

All types of instructions are called as a group - software. They are stored on diskettes or cassette tapes so that they do not have to be retyped, just as one stores information on a record or audio cassette. The term software is often applied to the diskette as well as the instructions recorded on it. (Show diskette which has been taken apart). The instructions can be loaded into the memory from the disk or cassette each time you wish to use them. After the program is loaded one can execute it; that is, by typing RUN, we command the computer to carry out each instruction one at a time, beginning with the first instruction. If there are mistakes in the instructions, the computer will not evaluate, but perform them as written. To DEBUG a program is to find and correct mistakes.

EDUCATIONAL APPLICATIONS

A. Objectives

Main: Describe teacher, administrative, and student applications of microcomputers.

Subobjectives

1. Discuss the role of microcomputers in elementary and secondary schools.
2. Describe and define CMI and other teacher and administrator-focused applications of microcomputers.
3. Describe and discuss examples of Drill and Practice, CAI, Simulations, and Game microcomputer software.
4. Describe project activities at the TSB computer club.
5. time permitting, To engage participants in discussion of the role of microcomputers in their and other schools.

B. Equipment

1. Apple II Plus and TRS-80 microcomputers
2. Software
    a. CMI= VISICALC GRDBOOK (Apple)
    b. D&P= Talking Color Math (Apple)
    c. CAI= Workshop.BAS (Apple)
    d. Simulations= LEMONADE (Apple)
    e. Games= SNOGGLE (Apple)

C. Activities

1. Introduction
2. Controversial issues of educational applications
3. Teacher and Administrative applications
4. Student-focused applications
5. Discussion (time permitting)

Educational Applications
Concept Outline

Introduction: What can micros do for education?

a. Why consider educational applications?
   - In-school uses interest parents and teachers
   - Home applications
   - Let's expensive home computers "give something back,"

b. A Framework
   R. Taylor's book, The Computer in the School: Tutor, Tool, Tutee
   - the preferred order will be Tutor, Tutee, Tool

Tutor

CAI or CBI: That is the Question?

a. CAI = Computer Assisted (B=Based) Instruction

b. Advantages
   - involvement of student in the learning process
   - self-paced/self-directed
   - immediate/systematic reinforcement
   - can simulate time/space, dangerous, or expensive situations easily
   - frees faculty for other activities
   - continuing ed. and remedial ed. cost effective

c. Disadvantages
   - requires more from tried methods to UNTRIED for teachers
   - poor, incompatible, undocumented, software (few "experts" to turn to)
   - cost (hardware, software, technical assistance, maintenance)

d. Implementation Projects
   - CONDUIT @ U. of Iowa
   - MECC @ Lauderdale, MN
   - J. Chamber's CAI project, Cal. St. U., Fresno
   - A. Bork CAI Project, U. of Cal., Irving
   - P. Suppes CAI Russian & Math, Stanford U.
   - PLATO, U. of Illinois
   - TICCIT, U. of Texas & BYU (English & Math)
   - Nat'l. Dev'l Proi. in Comp. Asst. Lrn. (NDPCAL), United Kingdom
   - Chicago City Schools Project

e. Evaluation of CAI/CBI/CAL and other projects ETS's evaluations of PLATO & TICCIT
   (1) PLATO
      - accounting, bio., chem, English, & math
      - Achievement incr. for math only, but positively viewed by students.
   (2) TICCIT
      - math and English
      - sign. achiev. effect in math, fewer students completed
      - also sign. achiev. effect in English with equal completion rate

f. Intelligent CAI
SCHOLAR - geography tutor
SOPHIE - electronics troubleshooting
WHY - meterology tutor
WEST - coach for game playing
BUGGY & DEBUGGY - math diagnostic

g. Conclusions about CAI

(1) CAI can be effective for task analysable instructional materials.
(2) CAI has an attractive potential for the ARMY. Their experts serve better on-the-job rather than doing training. Computers can improve manpower utilization.
(3) CAI is particularly well-suited for training in performance skills.
(4) Will be key application in USER-FRIENDLY capabilities of other types of computer uses. E.G., CAI will be available to teach users to USE WORD PROCESSING, TO PROGRAM, or TO OPERATE ELECTRONIC SPREADSHEETS

h. Other Computer-based Teaching Aids

While CAI is the most common Tutor application, there are classification schemes which list "teacher assistance" as a heading, which includes more than CAI.

(1) CMI: Computer Managed Instruction
  - keyed to textbooks
  - generates tests
  - scores tests
  - suggests areas for remediation
  - tracks student progress
  - generates student report cards
  - generates parent reports
  - e.g., Holt, Rinehart & Winston System on CPM's or Manage A Token Economy with Graphing

(2) Simulations
  - Becker (1982) states the "realities" of education are that one-to-one computer/student ratios are not in our immediate future.
  - Therefore, CAI is impractical and programs which can be used with groups must be sought
  - Simulations can easily be used with groups
  - There are two types:
    (a) those attempting to perfectly simulate reality.
    (b) those which produce unusual or impossible situations in order to highlight critical concepts
  - Advantages include the ability to condense space and time, and to produce large scale or expensive effects inside the classroom.

(3) Drill & Practice Programs:

Simpler than CAI, they do not attempt to teach, but rather assume information has been presented and simply drill students to higher level of proficiency--Most common, most limited educational use of microcomputers--widely applicable for "learning disabled (LD)" students.

(4) Games

A final instructional application of computers is the contingent use of games as reinforcers. Some computer-based games can be strong work motivators.

(5) Authoring Systems - Pilot, Author, etc.

i. Conclusions:
- (1) CAI is the most commonly available instructional use of micros.
- (2) It is very limited in scope and this type of software, in large, remains of low quality and focused on one-to-one use.
- (3) Hopes for the future include MECC, Conduit, MicroSIFT, etc.

Tutee

Tutee is the student "teaching" the computer--the best example is "programming."

a. Programming skills are often the definition of Computer Literacy - Luehrmann (in Taylor, Ed.)

b. BASIC vs. LOGO vs. PASCAL vs. etc.
- (1) Structure seems important
- (2) State requirements will impact the issue.
- (3) Ubiquity of BASIC
  - POSITIVE: Commonality of skills/programs
  - NEGATIVE: (QWERTY) - reliance on old technology

c. LOGO Advantages/Claims
- (1) Math & LOGO can be learned like natural language (therefore, better by children)
- (2) LOGO structure is an heuristic for other problem-solving tasks
- (3) Socialization between students will be improved
  - subversion
  - student experts
  - time on-task interaction (peer tutoring)
- (4) Can "concretize" formal tasks
- (5) Piagetian commitment to using pre-existing knowledge of child (e.g., body syntonics)

d. Tutee Conclusions
- (1) Holds the most promise for significant impact of microcomputers on education
- (2) Requires the most change! Traditional system is slow to change, though.
- (3) Claims for both immediate (vocational) benefits and broad educational (cognitive) benefits need yet to be tested and verified.
- (4) The role of teacher prep. programs in schools of education will be critical.

Tool

Marc Tucker and others have pointed out that like colleges have high demand for computer resources but rarely offer computer-based classes, elementary and high schools may come to use microcomputers for everything but instruction.

a. Tool Applications include. . .
  (1) Word Processing - programs which allow the easy manipulation of text for adding, deleting or substituting material prior to printing it out.
    (a) Bank Street College has studied this showing improvement in writing skills and spelling.
    (b) requires typing ability

  (2) Electronic Spread Sheets - programs, like VisiCalc, which allow the simultaneous interactive display of labels, numbers, and equation solutions.

  (3) Data Base Management Systems - programs which allow the filing and searching of information.

  (4) Data Analysis - programs which produce visual displays (e.g., graphs, summaries, or complex analyses of numerical data.

b. Administrative Uses: student records, inventory, scheduling, financial management, payroll, federal reports and census.

c. Conclusions

  (1) Dynabook and other projects suggest the high aims and potentials for tool applications.

  (2) Simpliest and least likely to meet resistance of all applications.

Ethical and Social Issues

a. Male/Female Bias

M. Lepper at Stanford has found that aggressive reinforcers incorporated into CAI programs benefit boys while "no reinforcers" are better for girls. When "helpful" (e.g., ET escape) are the reinforcers, the opposite effects are found.

T.W. Malone has a checklist which suggests reinforcers should be used. . . but what type?

b. Home-based Education and Interaction Video/TV channels. Will home-based education eliminate socialization with peers?

Papert recommends the bullfighting train model of S. America--students learn on their own, then convene regularly at "Conventions" where all levels of practitioners participate and are there to aid one another.

c. Enhanced SES Disadvantages
  - Imagine if a program existed that if used for a year would add 20 points to IQs ... but it was only available on a $10,000 LISA system.
  (1) Are micro. educational advantages only available to the rich?
  (2) Could this not enhance already existing social classes?
  (3) Do we need micro. libraries?

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ACCESS TECHNOLOGY

A. Objective - To introduce and describe devices which allow visually impaired youth to access microcomputers.

B. Equipment

1. Apple computer
2. Cassette Braille (VersaBraille)
3. Optacon and CRT lens
4. Synthetic Speech (Total Talk and Type-N-Talk)
5. Digitized Speech (Supertalker)
6. Software-generated Large Print (Higher Text)
7. Hardware-generated Large Print (Visual-Tek)

C. Activities Outline

1. Cassette Braille
    a. description
    b. advantages and limitations
    c. questions

2. Voice
    a. Synthetic Speech
        (1) description
        (2) advantages and limitations
    b. Digitized Speech
        (1) description
        (2) advantages and limitations
    c. Questions

3. Optacon and CRT lens
    a. description
    b. advantages and limitations
    c. questions

4. Large Print
    a. Hardware-generated
        (1) description
        (2) limitation and advantages
    b. Software-generated
        (1) description
        (2) limitation and advantages
    c. Questions

5. Summary of need for multimedia approach and tailoring to needs.

VI. Access Technology
Concept Outline

A. Cassette Braille Devices
  1. Description
    a. Devices
      1) VersaBraille
      2) Microbrailler
      3) Braillex
      4) Braillochord
      5) Braillink
      6) Rose Reader
      7) AFB's project full-page braille display
      8) Cranmer's Modified Electric Perkins
      9) DELTA Reader
      10) MD Computer Braille attachment
      11) DATABRAILLE (3 in. floppies, 16K buffer, 80 cells)
      12) BD, 80 by K.-P. Schonherr, Germany

  2. Braille Display
    a. Movable pins in 6-dot braille cell (BD 80 has 8-dot)
    b. 20-40 cells of braille information (DATA Braille & BD 80 have 80 cells)
    c. Braille characters formed by moving pins up or down to form cell
    d. Characters sent from keyboard or microcomputers
    e. CMPB uses paper

  3. Cassette Tapes and Storage
    a. Audio-encoded braille on cassette tape
    b. Information on tape activates braille characters
    c. 1,000 characters can be stored before page turning with Versa (2,000 on other machines)
    d. 7 braille volumes on one tape

  4. Capabilities
    a. Editing of previously stored information
    b. Computer translation
    c. Grade I translation

  5. Interplay with Computer
    a. Serve as braille terminals for computers
    b. Braille input - typing information on machine's keyboard
    c. Braille output - reading response on display

  6. Limitations
    a. One braille line (no search capability)
    b. Expense
    c. Weight
    d. Only Grade I
    e. Ignores grapics
    f. Slower than Voice or Regular Print
    g. No widely accepted standard computer braille
    h. Tapes not interchangeable

7. Advantages
    a. Both input and output in braille (single medium)
    b. Allows storage and review (not in Grade II)
    c. Accurate character representation (vs. Voice)
    d. Speed faster than Optacon

8. Discuss Developments in New Technology (Cramner-Perkins Terminal) and Special Software
    a. Braille Edit Word Process and Translator System
    b. Duxbury Translater on Microcomputer ($1000 Apple with Softcard or IBM-PC with CPM)

II. Voice Output
  1. Digitized Speech
    a. Descriptions
      1) recorded human voice
      2) recorded on floppy disk
      3) high quality voice output

    b. Limitations
      1) small selected vocabulary
      2) must have software, cannot access all micros/programs
      3) each program must be modified
      4) no search of review capability
      5) ignores graphics

    c. Advantages
      1) excellent quality speech
      2) can enhance with inflection, accents, and expression

  2. Speech Synthesizer
    a. Descriptions
      1) speech-like words from electronic sounds
      2) unlimited vocabulary - concatenated phonics
      3) access to microcomputer without customizing each program software

    b. Limitations
      1) low speech quality/mispronunciations - imprecision
      2) no search/review capabilities
      3) ignores graphics
      4) output only

    c. e.g., Vert 6000(TSI, $5995.), FST (Triformation,), Total Talk (MD Computer,)

  3. Optacon
    a. Description of Basic Device
      1) reads printed material
      2) hand-held camera
      3) tactile image of 144 vibrating pins beneath finger
      4) reads contrast (light-dark)

b. Description of CRT lens
    1) lens attached to hand-held camera
    2) CRT enables reading characters displayed on screen
    3) no additional micro equipment necessary

c. Limitations
    1) bi-manual coordination
    2) slow reading speeds
    3) requires additional reading medium skills
    4) output only

d. Advantages
    1) full-screen search capability
    2) paper and screen-based output can be accessed
    3) does not alter mode of program delivery (graphics remain)

4. Large Print
    a. Description
        1) Hardware generated
            a) e.g., TRS-80 shift
            b) limited to double-width, same height

        2) Software generated
            a) flexible types and sizes
            b) added to any program as a subroutine

        3) Peripheral
            a) VisualTek CCTV system and LPC
            b) Perkins Video Scope (not computer compatible)
            c) Sensory Aids Corp. View Scan with EPSON Micro ($6000)

    b. Limitations
        1) Hardware: single size
        2) Software: requires program modification
        3) Peripheral: typically very invasive or requires separate system

    c. Advantages
        1) serves largest portion of visually impaired population
        2) does not effect mode of program delivery (graphics remain)

5. General Limitations of Access Devices
    a. Require additional start-up procedures
    b. Require initialization of peripherals through DOS (operating system commands)

TABLE 1
SUMMARY OF SURVEY I (1980)

	Microcomputers in Academic Curriculum	Microcomputers in Vocational Curriculum	Future Academic Plans for Microcomputers	Future Vocational Plans for Microcomputers
Response Rate 35 of 158 (22%)	1	1	11	9
As % of 35 Total Responses	2.9%	2.9%	31.4%	25.7%

TABLE 2
RESULTS OF SURVEY II (1981)

	Current Programs	Future Plans	Interested in Workshop Material	Have Funding	Equipment						
					Digi	Versa	Any PBR	OPTACONS	KRM	Micros.	CCTVs
Response Rate 44 of 158 (28%)	10	25	31	25	1	8	8	37	22	13	29
As % of 44 Total Responses	23%	57%	70%	57%	2%	18%	18%	84%	50%	30%	66%

TABLE 3a
RESULTS OF SURVEY III (1983)

Response Rate 91 of 158 (58%)	Current Programs	Future Plans	Interested in Materials	Current Funding	Future Funding
# of Schools	31	65	78	38	46
As % of 91 Total Responses	34%	71%	86%	42%	51%

TABLE 3b

# of Schools	Micro-Computers	VersaBraille Model P2	MB2400 Microbrailler	Modified Perkins	Other CBM	OPTACONS	OPTACON CRT Lens	Echo II	Votrax TNT	MD. Computer Total Talk	Kurzweil	Other Synthetic Speech	Supertalker	Other Digitized
Current 83'-84'	40 6	28 5	6 2	4 3	3 1	65 2	16 3	16 3	9 3	9 0	37 1%	12 2%	1 0	4 0
As % of 91 Total Responses	44% 7%	31% 5%	7% 2%	4% 3%	3% 1%	71% 2%	18% 3%	18% 3%	10% 0	10% 0	41% 1%	13% 2%	1% 0	4% 0

Other Access Devices					
LED-120	LED-15	CCTV	Viewscan	FSST	Braille-Edit (software)
12	1	2	3	2	2
13%	1%	2%	3%	2%	2%

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RESEARCH ON MULTIMEDIA ACCESS TO MICROCOMPUTERS FOR VISUALLY IMPAIRED YOUTH

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WORKSHOP HANDOUTS

July 7, 1983

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Advantages and Limitations

Cassette Braille Devices

Advantages:
1. Both input and output in braille (single medium)
2. Allows storage and review (not in Grade II)
3. Accurate character representation (vs. voice)
4. Speed faster than OPTACON

Limitations:
1. One braille line (no search capability)
2. Expense
3. Weight
4. Only Gade I
5. Ignores graphics
6. Slower than voice or regular braille
7. No widely accepted Computer Braille Standard
8. Tapes not interchangeable

OPTACON

Advantages:
1. Full-screen search capability
2. Paper and screen-based output can be accessed
3. Does not alter mode of program delivery (graphics remain)

Limitations:
1. Bi-manual coordination
2. Slow reading speeds
3. Requires additional reading medium skills
4. Provides output only

Speech Synthesis

Advantages:
1. Rapid reading rate
2. Braille skills not required (broader users pool)
3. Attempts all output
4. Unlimited vocabulary

Limitations:
1. Low speech quality/mispronunciations
2. No search/review capabilities
3. Ignores graphics
4. Output only

Digitized Speech

Advantages:
1. Excellent quality speech
2. Can enhance with inflection, accents, and expression

Limitations:
1. Small selected vocabulary
2. Must have software, can not access all micros/programs
3. Each program must be modified
4. No search or review capability
5. Ignores graphics

Large Print

Advantages:
1. Serves largest portion of visually impaired population
2. Does not effect mode of program delivery (graphics remain)

Limitations:
1. Hardware - single size
2. Software - requires program modification

General Limitations

1. Require additional start-up procedures
2. Require initialization of peripherals through DOS (operating system command)

GLOSSARY OF TERMS

Access Equipment - Devices which allow access to computers by visually impaired persons.

Accoustic coupler - A device that allows a terminal to communicate over the telephone with a computer.

AFB's full-page braille display - full-page cassette braille recorder currently under development.

BASIC - Beginner's All-purpose Symbolic Instruction Code: an easy to learn programming language built into most microcomputers.

Braillex - A cassette braille recorder (See Cassette Braille Recorder)

Braillink - A cassette braille recorder (See Cassette Braille Recorder)

Boot - To start up a computer system by loading a program from a disk or tape.

Branching Program - Instructional program in which the segments are branched to depending on learner responses.

Buffer - A temporary storage area where data can be stored until needed for the next step.

Byte - A unit of information used to represent one character. In the computer's memory, it is typically composed of seven or eight switches processed as a unit.

CAI - See Computer Assisted Instruction.

Capacity - Refers to the amount of information (i.e.. number of bytes) a computer can store and handle. (See memory)

Card - A removable printed-circuit board that plugs into an expansion slot inside the computer. This board expands or modifies the computer's capabilities. For example, it can increase the memory of the computer, add voice output, or allow the user to plug in a printer or terminal.

Cassette Braille Recorders (CBRs) - microprocessor-based devices which use standard audio cassettes to store and retrieve sound-encoded braille.

Cathode Ray Tube (CRT) - A TV-like screen used to display information generated by a computer. This device is also called Video Display Terminal, monitor, screen, visual display.

Central Processing Unit (CPU) - The brain of the computer. It is the circuit which carries out the instruction specified by the program.

Character - Any symbol that a computer may read, store, or write: the symbols include the letters A to Z, the digits 0 to 9, punctuation symbols and operation symbols.

Chip - A small piece of silicon on which an integrated circuit is etched. The term is often used to refer to an integrated circuit and its package.

CMI - See Computer Managed Instruction.

Coding - The act of writing a sequence of computer instructions to accomplish a desired task.

Computer - A device capable of accepting data, performing prescribed operations on the data under the direction of a stored program, and supplying the results of these operations.

Computer Assisted Instruction (CAI) - A method in which instructional material is presented to a learner through a computer controlled environment.

Computer Managed Instruction (CMI) - The computer assists the teacher in managing a learner's instruction. The computer monitors student progress through an instructional sequence and makes decisions on further instruction.

Computerized Testing - The computer administers, scores, and interprets tests.

Copy-protect - Precautions taken to prevent unauthorized duplication of programs.

Courseware - Software designed especally for CAI application (including broad instructional goals).

CPU - See Central Processing Unit.

Cranmer Modified Perkins Brailler - Maryland Computer Service's low cost braille printer which can be used to access computers through paper braille.

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CRT - See Cathode Ray Tube.
CRT Lens - A special lens which allows the OPTACON to be used with a video display (see OPTACON).
Cursor - A pointer displayed on the computer's screen that marks were the next character typed from the keyboard will appear.
Data processing - The handling of facts: business data processing refers to computer analysis of quantified data about a business.
Digicassette - Triformation System's cassette braille recorder (see Cassette Braille Recorder and Microbrailler).
Digitized speech - Human speech that is converted to a form that can be stored in a computer's memory. Once stored, it can be played back under the control of the computer.
Disk - A flat, circular, magnetic surface used to store information in a manner similar to the way sounds are recorded on tape.
Disk Drive - A device which allows the computer to read from and write to magnetic disks. It is much faster than tape drives.
Echo II - A low cost synthetic speech device. (See synthesized speech.)
Electronic Spread Sheets - Programs such as VisiCalc, which can solve formulas interactively and simultaneously.
Execute - To carry out the actions indicated by a set of instructions such as those contained in a program.
File - A collection of information stored on a disk or tape and referenced by a unique name. The file could be a program, a document, or a list.
Free Scan Speech Terminal (FSST) - Synthetic speech terminal from Telesensory Systems (See synthetic speech.)
Graphics - Information presented in the form of pictures on the computer's screen.
Hardware - The physical equipment making a computer system. It includes the mechanical, electronic and magnetic units in a computer.
I/O - See Input/Output.
Interactive - The process by which a computer and it's user respond to one another.
Interface - The devices and instructions that allow one component of a computer system to communicate with another. This could be a cable, a program, or a printed circuit board.
Input/Output (I/O) - Devies which provide communication between the computer and the user, e.g., keyboard (input), screen (output), CBRs (both).
Integrated Circuit - An electronic component consisting of many circuits etched onto a single silicon chip.
ITS (Information Thru Speech) - A computer system from Maryland Computer Service which includes synthetic speech, braille output, and specially designed software.
Keyboard - Similar in appearance to a typewriter keyboard, the computer keyboard allows a persn to send information to the computer.
Language - A language is a set of rules specifying how to tell a computer what to do. Examples of different languages are: ALGOL, BASIC, COBOL, FORTRAN, LISP, RPG, LOGO, and PASCAL.
Large Print - Increased size of printed material by using the computer graphic capabilities. Useful for partially sighted learners.
Linear Programming - Instructional segments which are sequenced in a linear manner (i.e., one-by-one progression), without looping back to earlier steps.
Load - To copy information from peripheral storage, such as a disk, to main memory so that it can be executed or edited.
LOGO - A programming language created by Seymour Papert with educational principles in mind.
Mainframe - A large computer at a central site which handles many terminals in a time-shared environment
Memory - The maximum amount of information a computer can store at any given time--typically measured in K-units or 1024 bytes.

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Microbrailler - Latest model of the Digicassette (see Cassette Braille Recorder)

Microcomputer - The smallest type of computer presently available (e.g., APPLE, TRS-80) also called personal computers.

Microminiaturization - The process by which larger numbers of individual components can be squeezed onto smaller silicon chips.

Minicomputer - A small computer with more capabilities than a microcomputer which is often used in small businesses.

Modem - A device which allows a terminal to communicate with a computer via a telephone system by translating the computer's signals into audible signals. (See Accoustic coupler and Direct connect modem.)

Monitor - Se Cathode Ray Tube.

Network - A group of interconnected computers which can be individually controlled, but can share input/output devices.

OPTACON - An OPtical-to-TActile-CONverter which translates typed material to raised letters. These letters are formed by an array of vibrating pin, readable by touch. They are not braille characters!

PC Board - See Printed-Circuit Board.

Peripherals - Generic term for devices connected to a computer.

Printed-Circuit Board - A flat rectangular piece of fiberglass to which integrated circuits and other electronic components are attached.

Printer - A widely used output device that is used with a computer to print a "hard" copy, such as ink print or braille on paper.

Program - A sequence of instructions that direct the computer and coordinates the operation of various hardware components.

RAM - See Random Access Memory

Random Access Memory (RAM) - The internal memory of a computer that can be used to temporarily store a program or information.

Read Only Memory (ROM) - A permanent form of memory. Once set, it can not be changed. Used to make permanent programs

ROM - See Read Only Memory.

Rose Reader - Cassette Braille Recorder--not compatible with computers (see Cassette Braille Recorder).

Run - To execute a program.

Save - To copy the contents of memory onto a disk or tape for permanent storage.

Scroll - To move the information on the computer s screen up in such a manner that the top part of the screen is pushed out of view in order to make room for new information at the bottom.

Software - This is defined as any program for the computer which contrasts with the physical equipment of "hardware" of the computer system.

Synthesized speech - Artificial speech produced by combining sounds according to the rules of phonics.

Terminal - Any device that communicates to and receives communications from the computer.

Text - Information presented in the form of characters, such as letters of the alphabet, numbers, and punctuation.

Total Talk - Synthetic speech terminal from Maryland Computer Services. (Se synthetic speech.)

Type 'N Talk - Low cost synthetic speech device from Votrax. (See synthesized speech.)

Users' Group - An association of people who all have an interest in a particular computer/group of computers.

VersaBraille - Telesensory System's cassette braiille recorder (See Cassette Braille Recorder.)

Vert 6000 - Synthetic speech terminal from Telesensory Systems. (See synthetic speech.)

Videoscope - Closed circuit TV with a flexible mounting system used for producing

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large print. Marketed by Howe Press.
Viewscan - Portable system for enlarging print which utilizes a hand held camera.
Visualtek - Closed circuit TV system used for producing large print. Models are available for viewing computer screens.

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APPENDIX G

INDIVIDUAL SITE EVALUATIONS

TO: Micro Folks Kentucky March 22, 1982

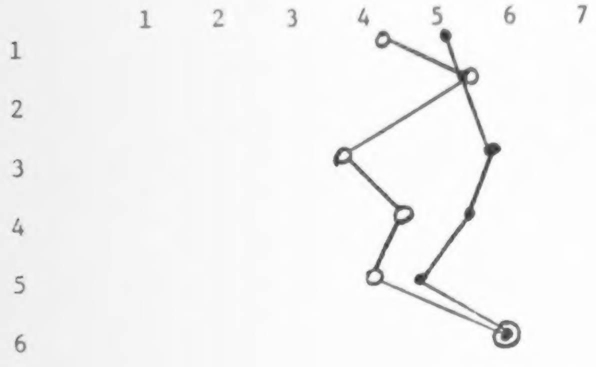
FROM: Anna

DATE: March 29, 1982

IN RE: Results of the pre-post test and evaluation forms. Please read over them and we will talk about it at the staff meeting.

PRE-POST

Semantic Differential	Pre	Post
1. Cold-Warm	$\bar{X}$ = 4.33	5.07
	s = 1.80	1.09
2. Unfair-Fair	$\bar{X}$ = 5.6	5.5
	s = 1.05	1.3
3. Dominant-Submissive	$\bar{X}$ = 3.93	5.9
	s = 2.28	1.09
4. Hostile-Amiable	$\bar{X}$ = 4.4	5.53
	s = 1.55	1.13
5. Complicated-Simple	$\bar{X}$ = 4.13	4.6
	s = 1.64	1.68
6. Frivolous-Practical	$\bar{X}$ = 6	6
	s = 1.07	1



o = Pre $\bar{X}$

● = Post $\bar{X}$

Likert N=15

	No Change	1 Plus	2 Plus	1 Minus
A	10	3	1	1
B	10	3	1	1
C	11	2	1	1
D	12	3		

6 participants registered no change on all questions.
1 participant changed all questions positively.
0 participants changed more than 1 question negatively

Multiple Choice N = 15 # correct of 5

Pretest	Posttest
$\overline{X} = 1.93$	$\overline{X} = 2.4$
s = .88	s = .99

Item Analysis (Posttest Only)

Correct Answer(?)		# of Answers A	B	C	D
A	1	13	1	1	0
B	2	0	3	1	11
D	3	0	3	8	4
B	4	1	1	12	1
C	5	0	0	15	0

Evaluation N = 16

I. Likert

	SA	A	D	Other
A	2	14		
B	2	13	1	
C	6	10		
D	2	7	6	1 between A & D
E	1	6	7	1 No answer

Scale 1 to 5 (1 = High)

	Content	Presenter	Presentation
1. General Technology	2.19(1-4)	2.25(1-4)	2.31 (1-4)
2. Micros in Soc. & Ed.	2.5 (1-5)	2.37(1-4)	2.44 (2-4)
3. Voice	1.18(1-4)	1.19(1-3)	1.75 (1-4)
4. Cassette Braille	2.25(1-4)	2.19(1-4)	2 (1-3)
5. Optacon	1.93(1-5)	1.87(1-4)	1.87 (1-5)
6. Large Print	1.94(1-4)	2.06(1-4)	1.94 (1-4)

Positive

See and hands-on equip. - 8 responses

Possible uses

Created curiosity to learn more

Excellent speakers

Negative

Not enough hands-on time - 4 responses

Organization (not prepared) - 5 responses

Handouts (poor quality, bad braille) - 5 responses

Slides - 4

Terminology - 3

Suggestions

- having well written objectives and telling group of each.
- Presenters were "unsure" are you really sold on their uses in the classroom
- Need more practical hands-on and how to use with students
- Handout on each piece of equipment
- Terminology ahead of workshop

Anna's Comments

- Beware of vocabulary-input, output, explained later but not at beginning, also abbreviations.
- Integrate slides or get rid of them.
- "computers are becoming people" statement - Ken, watch it.
- "Vicious" - Mike, watch it.
- Micros in society and micros in education were very much overlapped. Seemed redundant.
- Are handouts in the correct order?
- Watch "this one" and pointing. Does not mean a thing to the blind folks.

- watch saying "are we going to cover this later"
- I keep hearing "cost effect" type statements from the group.
- whoops - we're losing almost 1/3 of the group during "hands on"

Suggestions

1. Prepare a packet with terminology, equipment handout, all handouts and send ahead of tim. Transcribe good (Br. II) braille or not at all.
2. Organize sections with specific objectives and make participants aware of them before each presentation.
3. Combine "Micros in society and education" (in a broad sense)
4. Create new section with applications for students, blind students and blind multihandicapped students. POUR on application.
5. Organize and integrate slides
6. Plan the hands-on section more specifically so we don't loose the interest.
7. The content is there. You all know what you are talking about. We just need more organization and polish.

Sandy' Comments

1. Written, not oral pre-post
2. Better slide organization
3. Less on general technology and computers in general.
4. All materials in good Grade II braille.
5. Listen to tapes carefully and write advantages and disadvantages.
6. Have Versa charged and plugged in.
7. Better total organization -- flow, people utilization

TO: Micro Folks

FROM: Anna

DATE: June 16, 1982

RE: Results of the Evaluation data from Georgia Workshop

PRE-POST

Semantic Differential N=16

	PRE	POST
1. Strong-Weak (P)	$\bar{X}$ = 4 sd = 1.9	5.63 1.45
2. Bad-Good (E)	$\bar{X}$ = 5.69 sd = 1.66	5.93 1.06
3. Fast-Slow (A)	$\bar{X}$ = 2.81 sd = 1.42	5.69 1.54
4. Passive - Active (A)	$\bar{X}$ = 5.37 sd = 1.41	5.69 1.54
5. Pleasant - Unpleasant (E)	$\bar{X}$ = 2.75 sd = 1.48	6.00 1.26
6. Small - Large (P)	$\bar{X}$ = 4.1 sd = 1.48	3.87 1.89
7. Heavy - Light (P)	$\bar{X}$ = 4.3 sd = 1.14	3.81 1.68
8. Dull - Sharp (A)	$\bar{X}$ = 5.13 sd = 1.15	5.93 .85
9. Clean - Dirty (E)	$\bar{X}$ = 2.38 sd = 1.41	6.13 1.02

Semantic Differential Across Dimensions

	PRE	POST
1. Evaluative Dimension	$\bar{X}$ = 5.58 sd = 1.46	6.02 1.10
2. Potency Dimension	$\bar{X}$ = 4.12 sd = 1.51	4.56 1.82
3. Activity Dimension	$\bar{X}$ = 5.23 sd = 1.31	5.77 1.32

Lickert N = 24

Question	No Change	1 Plus	2 Plus	1 Minus
1.	13	8	1	2
2.	18	6	0	0
3.	12	9	1	2
4.	17	6	0	1

3 participants registered no change on all questions.
1 participant registered 2 plus change on two questions.

Multiple Choice N = 24 # correct of 5

Pretest	Posttest
$\overline{X}$ = 1.88	$\overline{X}$ = 2.58
sd = .90	sd = .97

Item Analysis (Posttest Only)

	Correct Answer	# of Answers A	B	C	D
1.	a	15	2	7	0
2.	b	0	15	0	9
3.	d	3	7	4	10
4.	b	1	2	21	0
5.	c	3	3	18	0

EVALUATION FORM

I. Likert N = 18

Question	SA	A	U	D	SD
1.	4	4	0	0	0
2.	2	2	4	0	0
3.	6	2	0	0	0
4.	2	4	2	0	0
5.	2	4	1	0	1

II. Presentation Ratings N = 7 scale 1 - 5 (5 = High)

	Content	Presenter	Presentation
1. Mircos in Society	4.16 (3-5)	4.43 (3-5)	4.43 (3-5)
2. Computer Technology	4.33 (4-5)	4.57 (4-5)	4.71 (4-5)
3. Edu. Applications	4.29 (4-5)	4.28 (4-5)	4.28 (4-5)
4. Cassette Braille	4.42 (4-5)	4.57 (4-5)	4.57 (4-5)
5. Voice Output	3.86 (3-5)	4.57 (4-5)	4.43 (4-5)
6. Optacon	4.57 (4-5)	4.57 (4-5)	4.43 (4-5)
7. Large Print	4.00 (3-5)	4.29 (3-5)	4.43 (3-5)
8. Hands-On	4.71 (4-5)	4.71 (4-5)	4.71 (4-5)

Comments:

Positive

2 responses - good applications for vocational situations like use of Versabrailler

2 responses - hands on experience; games; new educational ideas

2 responses - long enough to give insightful experience; presentations were excellent, efficient

Negative

More room and time; length of discussions; time involved

2 responses - poor ditto sheets

Anna's Comments

- better coordination of display of equipment and use of software. We could improve by being more organized about what program comes next so it will be ready when presenter is ready for it.
- hands-on needs work. We should rehearse this and make sure everything is set up and ready to go. Also exactly what will be covered and time for questions.

DeKalb County, Georgia   September 20, 1982

Results of the Evaluation Data from Workshop

PRE-POST

SEMANTIC DIFFERENTIAL   N= 15

	PRE	POST
1. Strong-Weak	$\bar{X}$ = 4.4	5.33
	sd = 1.40	1.34
2. Bad-Good	$\bar{X}$ = 5.13	6.06
	sd = 1.19	1.16
3. Fast-Slow	$\bar{X}$ = 3.5	5.40
	sd = 1.87	1.30
4. Passive-Active	$\bar{X}$ = 4.9	5.67
	sd = 1.44	1.05
5. Pleasant-Unpleasant	$\bar{X}$ = 3.27	5.80
	sd = 1.33	1.08
6. Small-Large	$\bar{X}$ = 4.33	4
	sd = .98	1.31
7. Heavy-Light	$\bar{X}$ = 4.13	4.80
	sd = 1.96	1.52
8. Dull-Sharp	$\bar{X}$ = 5.13	6
	sd = 1.25	1
9. Clean-Dirty	$\bar{X}$ = 2.33	6.47
	sd = 1.50	.83

SEMANTIC DIFFERENTIAL ACROSS DIMENSIONS

1. Evaluative Dimension	$\bar{X}$ = 5.18	6.1
	sd = 1.37	1.05
2. Potency Dimension	$\bar{X}$ = 4.02	4.24
	sd = 1.50	1.60
3. Activity Dimension	$\bar{X}$ = 4.86	5.6
	sd = 1.52	1.12

LICKERT N= 15

Question	No Change	1 Plus	2 Plus	1 Minus
1.	9	6	0	0
2.	9	5	0	1
3.	7	6	0	2
4.	10	5	0	0

MULTIPLE CHOICE N= 15 # correct of 5

Pretest	Posttest
$\overline{X} = 3.2$ sd = 1.37	$\overline{X} = 4.47$ sd = .74

ITEM ANALYSIS (POSTTEST ONLY)

	Correct Answer	# of Answers			
		A	B	C	D
1.	a	13		2	
2.	a	14		1	
3.	d	2		1	12
4.	c	1		14	
5.	c	3		12	

EVALUATION FORM

I. LIKERT N= 15

Question	SA	A	U	D	SD
1.	1	11	3	0	0
2.	6	6	0	2	0
3.	10	5	0	0	0
4.	3	8	2	2	0
5.	4	7	2	2	0

II. PRESENTATION RATINGS N= 15 Scale 1 to 5 (5 = High)

	Content	Presenter	Presentation
1. Micros in Society	4.23 (3-5)	4.31 (2-5)	4.38 (3-5)
2. Computer Tech.	4.40 (3-5)	4.47 (3-5)	4.40 (3-5)
3. Ed. Applications	4.13 (2-5)	4.27 (2-5)	4.27 (2-5)
4. Cassette Braille	4.33 (3-5)	4.27 (3-5)	4.20 (2-5)
5. Voice Output	4.20 (3-5)	4.20 (3-5)	4.40 (3-5)
6. Optacon	4.47 (3-5)	4.33 (4-5)	4.33 (4-5)
7. Large Print	4.40 (3-5)	4.40 (3-5)	4.40 (3-5)
8. Hands-on	4.20 (3-5)	4.33 (3-5)	4.27 (3-5)

COMMENTS:

Liked Hands On Experience ----------------- 7 Responses

Liked sequence, breakdown of information--- 2 Responses

Held interest------------------------------ 2 Responses

Opportunity to learn about access tech.

Wanted more hands on (too rushed, more time, some stations did not get to do anything)-------------------- 4 Responses

Too much information for one day, wanted longer workshop----------------------- 2 Responses

Morning too long without a break---------- 2 Responses

Wanted more application for V.I. Would like information on using micros with physically handicapped.

I. Directions: On the answer sheet, you will find seven lines lettered A through F. Each line has two opposite descriptors separated by seven numbers. I will give you a concept word and you are to express your opinion about the concept in relation to the set of descriptors. For example, if the concept word is "Internal Revenue Service" and the descriptors were "fair" and unfair," you might make an X over "1" or "fair" if you received a $600 return. If you had to pay $600, you might make an X over "7" or "unfair."

The concept word you are to consider is "computers." Please complete your seven judgments about the concept "computer."

A. cold - warm
B. unfair - fair
C. dominant - submissive
D. hostile - amiable
E. complicated - simple
F. frivolous - practical

II. Directions: On your answer sheet under question 2, you will find the letters A through D. Each letter has five choices: Strongly Agree, Agree, Undecided, Disagree, and Strongly Disagree. I will read a statement and you should place an X under the word that best describes your opinion about the statement. (Ask for questions.)

Statements

A. Access technology provides expanded vocational opportunities for visually impaired students.

B. Microcomputers are useful tools for visually impaired learners.

C. Computers are complex devices that are useful only to highly trained technicians.

D. Access technology is a fad and not really applicable to education for the visually impaired.

III. On your answer sheet, you will find five numbers. I will read a statement and several alternative answers. Please choose the most appropriate answer and record the letter corresponding to your answer.

1. The optacon can be used to:
   a. read a computer screen.
   b. provide an input mode for a microcomputer.
   c. read only printed material.

2. For visually impaired students, the paperless braille recorder provides:
   a. a technological sophisticated braille writer.
   b. a cassette tape storage system for braille information.
   c. a voice synthesis output.
   d. all of the above.

3. Computer digitized speech and computer synthesized speech are:

   a. the same computer, voice output system.
   b. capable of unlimited vocabulary.
   c. high quality voice output modes for computers.
   d. none of the above.

4. Microcomputer visual displays can provide assistance in instruction for:

   a. the teacher but not the visually impaired learner.
   b. large print readers.
   c. any visually impaired person.

5. According to Seymore Papert, the best educational application for microcomputers is:

   a. for Computer Assisted Instruction.
   b. Drill and Rehersal or material.
   c. exploration of the computer analogy to thinking.

EVALUATION FORM

1. Please indicate the extent to which you agree or disagree with the following statement by placing an X under the appropriate word(s).

	Strongly Agree	Agree	Disagree	Strongly Disagree
a. The subject matter was adequately covered.	______	______	______	______
b. The program was well paced within the allotted time.	______	______	______	______
c. The workshop increased my awareness of access technology and microcomputers.	______	______	______	______
d. Workshop activities increased my ability to apply knowledge about access technology and microcomputers to my professional activities.	______	______	______	______
e. Participation in this seminar changed my beliefs and attitudes toward access technology and microcomputers.	______	______	______	______

2. Please rate each unit in terms of content (new, relevant, useful); presentor (uninformed, articulate); and overall presentation (clear objectives, organized, engaging).

	Content	Presenter	Presentation
	High Low	High Low	High Low
1. General Technology (Ken)	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
2. Micros in Society & Educ. (Ken & Mike)	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
3. Voice Access (Susan)	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
4. Cassette Braille (Mike)	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
5. Optacon (Sandy)	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
6. Large Print (Susan)	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

3. Have you had any prior exposure to computers? __________ If so, explain.

4. What did you specifically like about the microcomputer workshop?

5. What did you specifically dislike about the microcomputer workshop?

6. Are you interested in continuing to use the computer? __________ If so, how?

Additional Comments:

VANDERBILT UNIVERSITY
INTER-OFFICE CORRESPONDENCE

Date: July 18, 1983

To: Micro Folks

From: Mike Young

Subject: July, 1983 - Nebraska Workshop Evaluation

PRE-POST TEST RESULTS

Semantic Differential N=25	Pre $\bar{X}$	s.d.	Post $\bar{X}$	s.d.
1. Weak - Strong (P)	5.84	1.46	6.36	1.22
2. Bad - Good (E)	6.28	.68	6.73	.45
3. Slow - Fast (A)	6.08	.86	5.42	1.21
4. Passive - Active (A)	5.92	1.87	5.65	1.65
5. Unpleasant - Pleasant (E)	5.64	1.29	5.96	1.25
6. Small - Large (P)	3.56	2.06	4.38	1.98
7. Light - Heavy (P)	4.04	2.41	3.77	1.95
8. Dull - Sharp (A)	5.64	1.25	5.96	1.04
9. Dirty - Clean (E)	6.08	1.12	6.62	.70

Semantic Differential Dimensions	PRE	POST
1. Evaluative	6.00	6.44
2. Potency	4.48	4.83
3. Activity	5.88	5.68

	PRE					POST				
LIKERT SCALE	SA	A	U	D	SD	SA	A	U	D	SD
1. Provide Opp.	19	5	1	0	0	22	4	0	0	0
2. Threatens jobs	0	0	1	11	13	0	0	1	4	21
3. = Complex	0	0	2	15	8	1	1	0	11	13
4. = fad	0	0	1	3	21	0	0	1	6	19

MULTIPLE CHOICE N=26

# correct of 5			
PRE $\bar{X}$	s.d.	POST $\bar{X}$	s.d.
3.77	1.11	4.38	.98

ITEM ANALYSIS (PRE)

	Correct		# of Answers			
		A	B	C	D	NR
1.	A	18	3	2	-	3
2.	A	23	0	2	-	1
3.	D	1	0	2	21	2
4.	C	2	5	14	-	5
5.	C	1	2	22	0	1

ITEM ANALYSIS (POST)

	Correct		# of Answers			
		A	B	C	D	NR
1.	A	24	1	0	-	1
2.	A	24	0	0	-	2
3.	D	0	1	0	24	1
4.	C	1	2	22	-	1
5.	C	1	2	21	0	2

EVALUATION RESULTS

LIKERT SCALE N = 18

		SA	A	U	D	SD
1.	hands-on responsive	8	6	3	1	0
2.	sustain interest	9	7	2	0	0
3.	increased my awareness	10	6	1	1	0
4.	increased knowledge of technology	7	7	4	0	0
5.	changed my beliefs	5	5	3	5	0

		Scale of 1 to 5 (5 = High)		
	Presentation Ratings	Content	Presenter	Presentation
1.	Micros in Society	4.29	4.29	4.23
2.	Computer Technology	4.29	4.47	4.47
3.	Ed. Applications	4.24	4.53	4.59
4.	Cassette Braille	3.76	3.53	3.65
5.	Voice	4.18	4.44	4.41
6.	Optacon	3.39	4.13	3.93
7.	Large Print	3.93	3.87	3.53
8.	Hands On	4.19	4.19	4.19

Prior Experience with Micros

NO	Some	YES
3	4	11
16.7%	22.2%	61.1%

PRE-POST TEST

I. Directions

Place an X on one line between each pair of words which shows your feeling about personal computers along that dimension.

Concept: Personal Computers

strong ___: ___: ___: ___: ___: ___: ___: weak

bad ___: ___: ___: ___: ___: ___: ___: good

fast ___: ___:___: ___: ___: ___: ___: slow

passive ___: ___:___: ___: ___: ___: ___: active

pleasant ___: ___:___: ___: ___: ___: ___: unpleasant

small ___: ___:___: ___: ___: ___: ___: large

heavy ___: ___:___: ___: ___: ___: ___: light

dull ___: ___:___: ___: ___: ___: ___: sharp

clean ___: ___:___: ___: ___: ___: ___: dirty

II. Directions

This scale is designed to enable you do indicate how you feel about particular aspects of personal computers and access technology. Please circle the letter(s) on the left which indicate how you feel.

SA = Strongly Agree
A = Agree
U = Undecided
D = Disagree
SD = Strongly Disagree

SA A U D SD 1. Access Technology can provide expanded opportunities for visually impaired students.

SA A U D SD 2. The use of microcomputers threatens the jobs and roles of teachers in schools.

SA A U D SD 3. Computers are complex devices that are useful only to highly trained technicians.

SA A U D SD 4. Microcomputers and access technology are a fad and not really applicable to education for the visually impaired.

III. Circle the letter of the phrase that most appropriately completes the statement.

1. The CRT lens is used with the OPTACON to:

   a. allow a microcomputer visual display to be read.
   b. provide an input mode for a microcomputer.
   c. produce braille translation of the microcomputer program.

2. When used as a microcomputer terminal, cassette braille devices give the user the ability to:

   a. gain access to microcomputer input and output in braille.
   b. use graphics in a program.
   c. use Grade II braille with the microcomputer.

3. Digitized speech and synthesized speech are:

   a. the same computer voice output system.
   b. useful when graphics are an important part of a program.
   c. equal in the quality of the voice output they produce.
   d. uniquely suited for different situations.

4. When a student uses large print to access the microcomputer:

   a. it is impossible to use graphics in the program.
   b. the hardware produces any size print the student needs.
   c. software modifications allow the widest range of print styles and sizes.

5. The role of microcomputers in elementary and secondary school education is:

   a. limited to drill and practice.
   b. solely reflective of a behavior modification emphasis toward special education.
   c. a controversial issue yet to be decided by educators.
   d. a potential threat to teachers' jobs and roles in education.

EVALUATION FORM

I. Directions:

This scale is designed to enable you to indicate how you feel about particular aspects of the workshop. Please circle the letter(s) on the left which indicate how you feel:

SA = Strongly Agree
A = Agree
U = Undecided
D = Disagree
SD = Strongly Disagree

SA	A	U	D	SD	1.	Hands on activities were responsive to my individual needs and interests.
SA	A	U	D	SD	2.	I learned enough through this workshop to sustain an interest in the uses of microcmputers and initiate planning for their uses in my classroom.
SA	A	U	D	SD	3.	The workshop increased my awareness of access technology and microcomputers.
SA	A	U	D	SD	4.	Workshop activities increased my ability to apply knowledge about access technology and microcmputers to my professional activities.
SA	A	U	D	SD	5.	Participation in this seminar changed my beliefs and attitudes toward access technology and microcomputers.

II. Directions:

Please rate each unit in terms of content (new, relevant, useful); presenter (uninformed, articulate) and overall presentation (clear objectives, organized, engaging).

	Content					Presenter(s)					Presentation				
	Low				High	Low				High	Low				High
1. Micros in Society	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
2. Computer Technology	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
3. Educational Applications	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
4. Cassette Braille	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
5. Voice Output	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5

	Content					Presenter(s)					Presentation				
	Low				High	Low				High	Low				High
6. OPTACON	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
7. Large Print	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
8. Hands-on Activities	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5

III. Have you had any prior exposure to micromputers?____________
If so, give details:

IV. What did you specifically like about the microcomputer workshop?

V. What did you specifically dislike about the microcomputer workshop?

VI. Are you interested in continuing to use the computer?__________
If so, how:

Additional Comments/Suggestions:

APPENDIX H

PROGRESS REPORT

4/5/83

PROGRESS REPORT

RESEARCH ON MULTIMEDIA ACCESS TO MICROCOMPUTERS FOR VISUALLY IMPAIRED YOUTH

Here is a brief status report on each of the five objectives:

1. In microcomputers, we are working primarily with Apple II Plus but also with TRS-80 Model III and have recently acquired an IBM-PC and an Apple IIe.

   We have used VersaBraille as the primary braille access device but have recently acquired a Microbrailler from Triformation Systems and have plans for the Modified Perkins Terminal (MPT) (Sandy Ruconich's dissertation is focused on the MPT). We also use the OPTACON with CRT lens.

   We use software generated large type and have recently acquired Visualtek closed-circuit TV equipment for print users.

   We use the Maryland Computer Services Total Talk, the Votrax Type 'N Talk, and the Echo II for voice synthesis access and Mountain Hardware's SuperTalker for digitized speech announcement of software. We have just acquired a Kurzweil Reaching Machine at the University.

2. We have developed a three-module instructional program for students' use. These modules have been pilot studied in our laboratory; pilot studied at the Tennessee School for the Blind and recently have been placed at the following schools for full field trials:

   Tennessee School for the Blind
   Kentucky School for the Blind
   DeKalb County Georgia Public Schools Program
   Nebraska School for the Blind
   New York Institute for Education of the Blind

   (LaRhea Sanford's dissertation is examining age and ability factors in learning to use microcomputers through these modules.)

3. We have presented workshops at Tennessee School, Kentucky School, the Georgia Academy and the DeKalb County Schools. We have plans for a regional workshop in Nebraska this summer, when we will be finalizing the teacher workshop materials.

4. We have acquired sample software programs and have generated a Draft Policy and Criteria for Software Evaluation.

5. We hope to engage you in our dissemination efforts through this and other means. We will appreciate your feedback.

George Peabody College for Teachers
VANDERBILT UNIVERSITY
NASHVILLE, TENNESSEE 37203 TELEPHONE (615) 322-7311

Department of Special Education • Direct phone 322-8265

April 11, 1983

Dear Colleague:

Thank you for responding to our previous surveys and expressing interest in microcomputer technology for visually impaired persons. We are currently involved in a federally funded project to improve visually handicapped students' access to microcomputers. This project has demonstrated that paperless braille recorders (such as TSI's Versa-Braille)can be used as "braille terminals" to access small personal-sized microcomputers, such as Radio Shack's TRS-80 and Apple II Plus. In addition, we have demonstrated the use of the OPTACON (using a special CRT lens) to read the microcomputer's video screen, to use the microcomputer-generated large print and closed-circuit TV for partially sighted students, and the use of voice synthesizers and digitized speech to produce spoken word output from the microcomputers.

This technology has proven effective in use by students and teachers at the Tennessee School for the Blind and other participating sites. The potentials for use by multihandicapped (as communication aids) and for the management of instruction by special education teachers (CMI) are being explored. We hope to continue to share our findings with other institutions serving visually handicapped persons.

Please take time to read the enclosed information summarizing the earlier survey results and detailing our progress toward project objectives. You can help us determine the need nationwide for information and assistance developed through project activities, by completing the attached survey form. If you wish further details, just specify your request under Question #5 on the survey sheet.

We hope to publish the results of this survey without revealing the identity of the respondents. We are eager to include your response in our findings.

We will appreciate the prompt return of our survey. Thank you in advance for your continued cooperation.

Sincerely,

S. C. Ashcroft
Principal Investigator

Michael Young

Michael Young
Project Manager

/pm
Attachments

Microcomputer Survey

1. Are you currently providing microcomputer access or microcomputer instruction to your students? (please give details under comments below). YES NO

2. Do you plan to provide microcomputer access or instruction to your students in the future? (please state when and what under comments below). YES NO

3. Are you interested in obtaining student use instructional materials and teacher workshop materials regarding available technology and applications of microcomputer accessibility for the visually handicapped? YES NO

4. Are funds or equipment available for your use in providing microcomputer experience for your students?

   Currently: YES NO In Future: YES NO

5. Are there any questions you would like answered on the topic of educational uses of microcomputers for the visually handicapped, not addressed by the enclosed materials?

   NO YES ______________________________

COMMENTS: (Please provide any further comments or questions regarding this survey or topic area.)

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Please check equipment available for your school's use:

	Currently	1983-84
Microcomputers		
VersaBraille (Model P2)		
Microbrailler 2400		
Perkins Terminal		
Other Cassette Braille Device		
OPTACON(s)		
CRT lens attachment		
Echo II		
Votrax Type-N-Talk		
Maryland Computer's Total Talk		
Kurzweil Reading Machine		
Other Synthetic Speech Devices		
Mountain Hardware Supertalker		
Other Digitized Speech Devices		
Other Access Technology (e.g., LED-120 braille printer Please Describe		

Name of Respondent ____________________ Title ____________________

APPENDIX I

LETTERS

Triformation
Systems, Inc.

MAY 17 1982

May 13, 1982

Professor S. C. Ashcroft
Principal Investigator
Peabody College of Vanderbilt University
Box 328
Nashville, TN. 37203

Dear Professor Ashcroft:

I am writing this letter to you to explain the long delay in receiving the paperless braille machine from Triformation Systems. At the time your college's order was taken for the DC-20M, we had a directive to discontinue manufacturing that particular machine. The DC-20M was unacceptable for use by the blind individual. Although the concept is exciting, the reliability of that particular machine was a question.

The replacement machine which will be available this month is a totally new product called the Micro Brailler 2400. There are several differences in this new machine, mainly its capabilities and reliability. Examples of the differences are: a new 24 cell display replacing the 20 cell display, and an active switch for selecting new lines versus the touch sensitive switch that was unacceptable on the old model. The Micro Brailler has an increased memory size. It now has the ability to store 1,000,000 braille characters on a 90 minute tape.

The MB-2400 is in production at present time. There are many units scheduled for shipment in June, among them will be your unit. Triformation Systems, Inc. is extremely excited about the production of the MB-2400 and the fact that it is totally supported in the United States by maintenance facilities. We were happy the DC-20M was not put in the hands of users and the above is one of the many reasons.

We hope this letter meets with your approval. We are extremely sorry for the delay in shipment. We do not wish to have our reputation for a reliable product destroyed as it would have been with the DC-20M. We hope you understand our position in this matter and will accept this letter as our promise that you will receive a reliable product.

Sincerely,

Carolyn Nelson

Carolyn Nelson
Marketing Dept.

CN

Triformation Systems, Inc. [illegible]

TELESENSORY SYSTEMS, INC.

455 North Bernardo Avenue
P.O. Box 7455
Mountain View, California 94043-5274

Telephone: 415-960-0920
Telex: 278838 TSI UR
Cable: Telesen Mountain View

MAY 31 1983

May 27, 1983

S.C. Ashcroft
Professor, Special Education
George Peabody College
Nashville, TN 37203

Dear Mr. Ashcroft:

Thank you for your inquiry about the Telesensory Systems, Inc. line of products. Please find information on the following products:

"Changes in the VersaBraille™ System"

You may wish to speak to your sales representative, Vinnie Rappa. He may be reached at:

7002 Oakview Circle
Tampa, FL 33614
(813)885-7668

Please feel free to call me with any questions that you may have. For ordering information, contact Kathy Kinkaid or Ray Davis in Sales Administration. We may be reached in the offices above. I look forward to hearing from you very soon.

Sincerely,

Telesensory Systems, Inc.

Kay E. Ehlers

Kay E. Ehlers
Inside Sales Representative

Encl.

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P27406
1/83

CHANGES IN THE VERSABRAILLE SYSTEM

Recently changes have been made in the VersaBraille unit software. These changes add features which enhance the VersaBraille System operation. The change that owners will most quickly notice is in the handling of audio. (Note new procedure under Overlay Changes.)

While both print and braille manuals are being revised, this print and braille insert will list and explain the changes that have been made. If you would like the revised manuals when they become available, please send your request to TSI, c/o Sales Administration. There will be no charge.

Configuration Control Parameters (CCPs):

1. LL (Line Length)
   There are several new line length options.

2. PL (Page Length)
   There are several new page length options.

3. CI (Carriage Return or End of Line Input)
   The (SP) option has been added to this parameter to specify translation of incoming carriage returns into single spaces.

4. CR (Carriage Return Delays)
   Some delay options have been dropped.

5. DCI (Device Control Input Enabled)
   This new parameter specifies whether the VersaBraille unit should react to or ignore incoming DC3/DC1 or X-ON/X-OFF controls.

6. CTS (Clear to Send Enable)
   The CTS parameter enables or disables use of the CTS control input (RS-232 pin 5) to stop and start transmission from the VersaBraille unit.

7. DSR (Data Set Ready Enabled)
   This CCP is no longer used, since it has been replaced by the CTS CCP. In fact, the DSR control input line (RS-232 pin 6) is no longer used at all.

TELESENSORY SYSTEMS INC.
455 Bernardo Avenue, P.O. Box 7455, Mountain View, California 94043-527
Telephone (415) 960-0920, Telex 278838

Summary of CCPs with new options:

b	(1200, 1800,2400, 4800, 9600, 50, 75, 110, 134.5, 150, 200, 300, 600)
d	(8, 5, 6, 7)
p	(e, o, n)
s	(1, 2)
t	(n, 1, c, x)
11	(80, 132,, 20, 38, 40, 64, 72)
pl	(0, 55, 72, 25, 27, 40, 55p, 72p, 25p, 27p, 40p)
ci	(n, sp, y)
cr	(0, 8, 32, 254)
et	(eot, em, fs)
dx	(h, f)
hs	(dtr, dc3)
ai	(n, y)
co	(cr, crlf)
ak	(y, n)
dci	(y, n)
cts	(n, y)
cd	(n, y)

Built in Functions

1. Control Character Prefix

Dot (4) will now be used as the computer braille control character prefix, in place of the Dots (4,5,6) representation, previously used. Dot (4) followed by a Dot (5) cell will represent "at" sign or accent grave,, depending on whether it is upper or lower case. Dots (4,5,6,) will now represent only the computer braille underline character, regardless of case. Dot (4) followed by a blank is now used to represent the ASCII null character.

2. End-Of-Page Warning Beeps

The first end-of-page warning has been moved forward to sound at 900. The second warning is still set to sound at the 960th character position.

3. Input/Output Buffer Clearing

The input and output buffers of the serial interface will no longer be cleared when the VersaBraille unit switches from local to remote I/O mode. Hence, data left holding in these buffers during local operation will still be available to finish sending or to receive when the unit is switched back to remote mode.

4. Receiver Buffer Extension

The serial data receiver buffer or input buffer is a memory that temporarily saves any data characters received on the interface while while the VersaBraille unit is busy doing other things. This buffer used to have a maximum fixed size of about 70 characters. Now the receiver buffer will be automatically extended to a total of about 970 characters, as long as there is no overlay program loaded in the VersaBraille overlay memory. If an overlay is loaded, the receiver buffer will be limited to about 70 characters. The significance of this buffer extension is that the VersaBraille system will be able to receive data at higher data rates without the need for handshake protocol controls.

5. The computer braille translater will be initially set to "Uppercase" when the VersaBraille is turned on or reset.

6. No Overrun Lock-up

Previously, the VersaBraille system tended to freeze or lock-up when the input or output buffers were overrun or over filled. The new unit should not lock up from buffer overruns.

7. Full Tape Continuation

The VersaBraille will now allow user to fill a tape and continue downloading information on another tape.

8. More Forgiving on Parity Problems

The ASCII translaters will completely ignore or "zero" the 8th bit of the ASCII data.

9. No Eject with End-Text

Receipt of an End-Text character (specified by ET CCP) now causes "new chapter," instead of "eject."

Single Chord Command Changes:

1. Z-chord (Transfer Terminate Command)

This new command will terminate the input or output transfer functions without causing an eject. It may be necessary to hold the Z-chord down for a while, (sometimes several seconds) until the system has had time to recognize it. In the case of the (R-chord I) and (X-chord P) output transfers, the transmission is stopped and the braille display is left at the top of the page that was being sent. In the case of the (R-chord T) input transfer, the automatic page turning stops and the display returns to the text at the cursor.

2. Q-chord (Continue Transmission Command)

This new command causes the VersaBraille unit to proceed with any transmission that has been halted when the VersaBraille unit received a DC3 (X-OFF) handshake character. It "fools" the VersaBraille unit into thinking that it has received a Control (Q) character (DC1 or X-ON). This command is for use when a printer or other device, attached to the VersaBraille unit, sends an X-OFF and does not follow up by sending an X-ON.

3. K-chord (Case Indicator Command)

This command causes the VersaBraille unit to beep twice for uppercase and once for lowercase, to indicate the case of the character at the cursor location.

Resident Command Changes

1. (R-chord C) Switching to Remote

Use of this command automatically switches the VersaBraille unit into remote mode. This eliminates the previous problem of getting locked up by evoking this command while in local mode.

2. (R-chord K) Break Command

A fixed length break signal of about 270 milliseconds will now be generated by the (R-chord K) command. Previously, this command began a break signal that was terminated when the operator entered another character or command (such as K-chord) on the VersaBraille keyboard. A terminating keystroke is no longer needed.

3. (R-chord I) With Cursor On

Starting the (R-chord I) transfer with the cursor turned on will now turn off the cursor automatically at the start of the transfer, in order to avoid the malfunctions formerly caused by having the cursor left on by mistake.

4. No End-Text with the (R-chord I) transfer.

The End-Text character (specified by the ET CCP) will no longer be automatically sent at the end of an (R-chord I) transfer. The operator will now be able to manually send whatever End-Text character(s) (if any) they need, via the VersaBraille keyboard.

5. "Full Tape" Condition with (R-chord T) Transfer

When the end of the tape is reached, during an (R-chord T) transfer to the VersaBraille, the VersaBraille system will now signal "Not Ready" with the handshake protocol specified by the HS CCP. It will then switch to local and eject. This will make it possible to load another tape, open another chapter, and continue the transfer. Previously, this was not possible because "Full Tape" condition was handled by transmission of the ET (End-Text) character and an eject in the remote mode with no "Not Ready" handshake signaling.

Overlay Changes

Audio Overlay

The audio mode tape recorder functions were removed from the PROM firmware to make room for more important functions. The audio functions are still available, however. They can be loaded as an overlay. If the audio overlay has not been loaded, pressing the audio mode button will result in an error beep. When the audio overlay is loaded, all the audio functions work exactly as they did when they were resident in the PROMs. Refer to P2 Manual, page 11 for overlay loading procedure.

Terminal Overlay Changes

1. (X-chord E) Error Indicator Dropped ,

The error indication function was removed to make room for more important functions.

2. "Loaded" Message Changed

The "open new chapter" message has been changed to "terminal loaded."

Duplicator Overlay Changes

1. Use with DTR-CTS Handshake Control

Use of DTR-CTS handshake control and a P2(C) as the master unit, can improve the reliability of duplication by eliminating the possibility of the master sending data when the slave is not ready for it. This requires setting the CTS CCP of the master VersaBraille unit to "y" and using a null modem cable adapter such as TSI Type 4 or Type 5.

Hard Copy Overlay Changes

1. Switching Between Remote and Local

When the (X-chord P) print function begins a transfer, it automatically switches to remote mode. It will now also switch back to local when the transfer is finished. Switching back to local will help to reduce errors introduced by unwittingly editing text in remote mode.

2. Blank Suppression

Previously, single or double blank characters were not sent if they immediately followed a carriage return. Now, only a single lone blank will be suppressed, and then, only if it follows an implicit carriage return (one automatically added by the hard copy routine).

3. Extra Line Feeds

When the CO CCP was set to CR, explicit carriage returns (those specifically entered by the user) were being expanded into carriage return plus line feed. Now, the addition of line feeds should occur only if CO is set to CRLF.

German and French Overlay Changes - for customers with this foreign language option.

Control Prefix Representation

The ASCII characters represented by the computer braille cells Dot (4) and Dots (4,5,6) have had their representations switched to Dots (4,5,6) and Dot (4), respectively. This switch does not handle all of the special exceptions dealt with in the standard American computer braille use of these two characters.

TELESENSORY SYSTEMS, INC.

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March 28, 1983

Mr. Nassir Mosa
P.O. Box 242
Peabody College
Nashville, Tennessee 37203

Dear Mr. Mosa,

Thank you for your call expressing your concerns and questions regarding the Microbrailler machine.

As a follow up to our conversation, I am enclosing a brief summary of our comments regarding the Microbrailler analysis prepared by Triformation. Please understand that our position is simply to accentuate the strengths of a system we feel is reliable, deliverable, serviceable, interfaceable, and multi-functional, namely the VersaBraille™.

- TSI has delivered over 1000 units throughout the world - this number represents not only the fact that we have manufactured and delivered these many units, but also the confidence and preference the respective blind users placed in our product. (Unconfirmed reports indicate that Triformation has delivered less than 10 Microbrailler units, that is, a total delivery of less than 1% of TSI's delivered VersaBraille units.)

- TSI's experience and expertise spreads throughout the world, with a network of sales and service offices in over 25 countries.

- TSI is a world leader in the manufacture of high technological aids for the disabled people. Our name is associated with reliability, respect, and satisfaction.

- TSI has already documented over 50 of the hundreds of interfaces used in the field. Our in-house application's engineer has, on a number of occasions, helped Versabraille users successfully resolve interface problems over the telephone! We have not seen nor are aware of any successful field interfaces with the Microbrailler.

- Our multi-functional Versabraille is as flexible as users would like it to be. Its programmed overlays allow it to be used as a quiet note taker, word processor, braille terminal, duplicator, tape recorder, etc. The Versabraille has built-in 18 I/O configuration control parameters with a total of 70 options, all user selected. This flexibility allows simpler interfacing with a variety of systems.

- Certainly, to everything one acquires, there is a price tag attached. However, TSI believes that the factor affecting the acquisition of equipment such as the Versabraille is not that of price, but cost-effectiveness. The productivity, output, capacity, and flexibility of the Versabraille system outweighs by far its acquisition investment. We suspect that one would have to invest much more than the price given by Triformation, if the user were to interface the Microbrailler with any device. The Versabraille system's cost includes all of the interface capabilities.

Further to the information provided, I review some interesting experiences:

Recently two major U.S. Government employers of blind people, the Internal Revenue Service (IRS) and the Social Security Administration (SSA), conducted some head to head comparative evaluations of the Versabraille System vs. the Microbrailler machine. This evaluation was brought on by the apparent lower price of Microbrailler promised by Triformation. As you may know the U.S. Government is required to give the business to the lowest bidder, unless some significant performance objectives are not met.

The Internal Revenue Service knew the Versabraille well from a previous 9 month evaluation of TSI's and Triformation's systems, and was prepared to buy sole source from TSI until Triformation asked if they could show their new device, not the one that had "failed" the previous 9 month evaluation.

The Social Security Administration already had some VersaBraille units, but was considering the Microbrailler because of price!

In both of the recent IRS and SSA evaluations, half a dozen blind employees and managers were brought in from around the country for a one-week long evaluation of the Microbrailler. Both evaluations ended before mid-week because Triformation left, taking all their equipment! It is apparent that their equipment did not function as promised.

Following the recent experience at SSA (early '83), a 3 month lease contract to continue evaluating the Microbrailler was cancelled.

The IRS has thus far ordered over 100 Versabraille units and SSA has already received over 3 dozen!

Should you be interested in contacting someone from either organization, their names and phone numbers follow:

IRS -- Mr. Jack Christiansen
Chief, Taxpayer Service Training Dept.
PHONE: 202-566-4550

SSA -- Mr. Frank Rousseau
SSA Management Training Division
PHONE: 301-594-3046

Regarding all this information, please do not copy or distribute widely. As I have expressed to you earlier, this is not our preferred method of marketing the VersaBraille system!

I hope this information will help you, the Saudi Arabian Mission, and/or the Saudi Arabian Government expedite the decision. We are beginning to quote June delivery for orders received now, due to a huge backlog of orders already received.

Should you have any questions, or need further help, please do not hesitate to contact me at (415)969-0920, Extension 293.

Sincerely,

Luis Kemeny

Luis Kemeny
Area Marketing Manager

LK:tmg

Encl: Microbrailler vs. VersaBraille System comparison.

ISSUES OMITTED IN TRIFORMATION SYSTEMS' COMPARISON
OF THE MICRO-BRAILLER 2400 AND THE VERSABRAILLE™ SYSTEM

ITEM	MB 2400 (PER TSI)	VERSABRAILLE (PER TSI)	EXPLANATION/IMPORTANCE (PER TSI)
1. Warnings of damaged data	reportedly, none	warns if data isn't trustworthy (via a triple beep)	VersaBraille warns when data retrieved from tape doesn't match the data as it was stored initially. (VB stores/monitors check sums which accompany taped data.) Indispensible warning when retrieving numeric data, like benefit records. False numbers are relayed when one data bit error goes unheeded.
2. Computer braille with case information (i.e., a complete 128 character ASCII set)	?	Yes, with supplemental audio cues	Without audio cues or extra dots to supplement 6 standard dots per braille cell, a writer of computer braille can't convey the case of a letter to a receiving printer and a reader can't determine the case of a letter coming from word processors and computers and (which today have both upper and lower case, unlike computers extant when computer braille began). Standard computer braille with only 64 cell shapes isn't useable for correspondence.
3. Grade I ASCII translator	?	Yes	Grade I is less cumbersome than even modified, complete computer braille for writing. Appropriate for letters and forms. Computer braille is best for receiving computer data when case is relatively unimportant. Only VB includes both translators. (i.e. ASCII - Computer Braille and ASCII - Grade I). (Reference: Appendixes D & E, TSI VB Owner's Manual, Vol. II.)
4. Grade II ASCII translator accessory	None	Yes	Via Apple II computer w/Braille Edit program written for VB and Apple. Helps typists do initial or more/local transcription, lets writer of Grade II braille type print copies, automatically.

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ITEM	MB 2400 (PER TSI)	VERSABRAILLE (PER TSI)	EXPLANATION/IMPORTANCE (PER TSI)
5. No. of peripherals accessible per unassisted user.	One, perhaps two. Interfacing involves mechanical dip switches, highly visual tasks requiring help and/or lots of time per interface change.	Not limited. Interface switches are software controlled, changed instantly by loading 1-page overlays containing control settings (which user(s) need not necessarily understand).	As Page 3 of VB Manual Vol. II shows, employment setings involve accessing multiple devices, independently. Information retrieval settings generally involve/require quick, frequent and independent connection to large computers, off-line printers (for forms and letters), phone modems (for electronic mail retrieval of transmittals), word processors (to access or share writing) and/or terminals (to type text-to-braille off line). Switch-interfaced devices are usable only in limited mobility work environments, and require mechanically adept people.
6. Text formatting & adjustable control pausing	?	Yes, via printer overlay & keyboard control of CCP's. (Pg. 21-23, VB Manual, Vol. II)	VB generates text without hyphenations and can drive printers lacking handshake protoco (which is missing in inexpensive printers). The VB keyboard can control pauses, vary line length, and page length. VB even halts printers to allow change of page.
7. Tape access time	?	Very fast	Only VB uses a high speed digital tape deck (at maximum speed consistent tape safety). VB's formatted tapes and chapter/page arrangements accelerate access times.
8. Tape duplication	? (During the Library of Congress study, only VB tapes could duplicate, others required regeneration from continuously - parenting computer)	Yes	Processes understood and well documented for VB. Easy duplication required for programs requiring sharing of info. Duplication now being done on a variety of inexpensive, personal as well as high quality tape duplication equipment.
9. Tape regeneration between two machines	?	Yes	Using duplication overlay, the new VB cassette copy has "as new" signal strengths. Limits deterioration of data when copies are very numerous (by creating multiple "masters").

TEM	MB 2400 (PER TSI)	VERSABRAILLE (PER TSI)	EXPLANATION/IMPORTANCE (PER TSI)
0. Software expandable	No, changed function requires changed hardware	Yes, via new overlays	Just as VB changes with terminal or printer or duplication or audio overlays loaded, it will grow as intended overlays are added and loaded by cassette.
1. Braille publishing house support	?	Yes	Gives multiple sources for text-to-cassette - braille and tape duplication. Underway at 4 major production houses for VB, especially to meet IRS requirements. VB can receive Grade II braille from computers, unclear if other braille machines can without major alterations of computers.
2. Remotely controllable	Highly unlikely without chords	Yes (See pg. 4, VB Manual Vol II)	Computers can fully control VB during automatic text-to-cassette braille transcribing to save production costs.
3. Automatic data transfer in & out	?	Yes	Means user needn't turn pages or get involved. VB prevents accidental over-writing of existing data, a real risk.
4. Option to filter control characters from received data	?	Yes (See pg. 6, VB Manual Vol. II)	By receiving only text from word processors VB user can edit without creating formatting problems. But, a user retrieving computer data will leave control characters in to know line position of the data as it appears on CRT screen.
5. Locate screen equivalent line number	?	Yes, via x-chord L (See pg. 27, Vol. II)	Important when retrieving screen-formatted info (which means nothing unless its location is known by line no. and column no.).
6. Adjustable carriage return output parameter	?	Yes (See Pgs. 22-23, VB Manual Vol. II)	Essential feature for controlling line spacing if printer to be used isn't predictable or if multiple devices at work site.
7. Audible warnings nationwide	?	Yes, 6 (See pg. 30, VB Manual Vol. II)	Machine friendliness, less user attention required for accurate use.
8. Nationwide Staff of Rehabilitation Professionals	?	Yes	TSI staff averages over 6 years of full-time work with blind people.

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TSI COMMENTS RE TRIFORMATION SYSTEMS' COMPARISON OF MICRO BRAILLER 2400 WITH THE VERSABRAILLE™ SYSTEM

ITEM	MB2400 (Per Triformation Sys.)	VERSABRAILLE (Per Triformation Sys.)	TSI's COMMENTS, CONCERNS
1. Cost	$4850	$6950	Low price is irrelevant if device is inadequate. These are prices, not costs. VersaBraille's functional capabilities required by most. VB performance matches promises because reliability is tested.
2. Warranty	1 year	1 year	TSI's service history excellent. VB works during warranty year, saving employee downtime, a hidden cost. MB performance not yet verifiable despite 1 1/2 years of promised delivery.
3. Extended Warranty	$300/yr.	$695/yr.	TSI has a service history. 1000 units in field guarantee service parts and consistency/service knowledge. Too few MB yet to assure long-term service costs or extended warranty price.
4. Battery life	8 hrs.	3 hrs., max.	VB is 3 hours, min., 3 1/2 - 4 avg. This is enough for most portable applications. Battery charge cycle is relatively unimportant at a desk.
5. Weight	8 lbs., built-in charger	15 lbs., external charger	VB weighs 12 pounds, the charger 3 lbs. A portable device should have a cover (lid) and handle. VB is portable.
6. Interface Ports	2	1	VB's single port is revolutionary and multipurpose due to unique idea of overlays which instantly reconfigure port operation, machine logic, and CCP's.
7. Tape Size	any size	60 minute	TSI consciously chose thicker, C-60 tapes to protect data from tape stretching, print thru noise, breaking and [illegible].

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ITEM	MB2400 (Per Triformation Sys.)	VERSABRAILLE (Per Triformation Sys.)	TSI's COMMENTS CONCERNS
8. Characters per tape	830K per C90	400K per C60	VB's 400K is consistently retrievable w/o data dropout. MB is apparently storing data 1.4 x as densely. Advantageous only if data integrity can be proven.
9. Preformatting	none required	30 min./tape	Formatting helps assure that a) tapes from one machine work on all others, & b) the machine is friendlier (keeps track of info locations more quickly and automatically, requiring less mechanical savvy). VB formats automatically when other tasks underway (lunch, etc.). No complaints.
10. Structuring of data	strings make flexible structure	page & chapter, no flexibility	There are advantages to both approaches. Only a string-based machine which does completely automatic advances thru text containing leap-frogged additions can approach VB flexibility. Provisions for inserting new data into full strings are critical. VB chapters are flexible, can be 1 - 200 pages each. Adding new pages to VB chapters is like adding strings in most systems.
11. Commands	by single letter	by chord	VB approach vastly superior. Chords are a) safety feature (the reason all computer terminals have control keys), and b) the way to dictate commands at a user's whim (not just when machines ask). VB now implements 47 chords, but has hundreds available for future uses.
12. Display Structure	Piezoelectronic, gold plated brass pins, pins pulled down by reeds	Piezoelectronic, plastic pins fall by gravity, friction adjustment	VB users rave about the feel, comparable to paper braille. Adjustable pins desirable, if all dots are to feel right. Metal pins reportedly feel bad, even if gold.

ITEM	MB2400 (Per Triformation Sys.)	VERSABRAILLE (Per Triformation Sys.)	TSI's COMMENTS, CONCERNS
13. Audio Recording	Any combination of audio or braille	2 audio tracks reduced to 1 when braille is on tape	VB's digital track is separated to protect easily accidental audio recordings over more critical braille (digital) info. VB avoids quarter track digital recording because signal strength and signal-to-noise ratios are poor, damaging data. (P.S. Audio filing is seldom used by braille users in employment. Audio commands are not resident in newest P2C VB's, but loaded as required, thru overlays).
14. Editing Space	2400 characters	1000 characters	Bigger is better only if supporting logic is comparable. To allow insertion/editing, both buffers need reserved spaces. With VB, audio warnings and a locate key help users leave adequate space for future insertions. Unknown if MB has such essential features. Because MB has 10 separate 240 character strings in buffer at any time and a string's location constantly varies, the problem of reserving spaces requires strictest user discipline unless friendly features compensate.